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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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Impugning the Book Review

WHETHER a book is praised, damned with faint praise or damned utterly, the giving of the price of a book at the head of a book review brands the review as an "advertisement," according to a Postoffice Department ruling noted and commented on at length on p. 378, in the Engineering Literature section of this issue. *Engineering News-Record* accepts the ruling but under protest against its unreasonableness. It is true that the ruling applies to other journals, both engineering and literary, but that only increases the number of readers of book reviews who are denied useful information as to price because of an arbitrary bureaucratic rule.

Development Committees' Conferees

THERE met at Montclair, N. J., last week the conference committee representing the development committees of the four leading engineering societies. What resulted from their deliberations is not, of course, to be known until the report is published. Even though it is not possible to record the results of the deliberations or to discuss them, it is fitting that the early meeting of the conference committee should be called to the attention of the profession. It indicates a disposition to get something done, to hurry the day when the profession can get to work on a plan that will be certain to receive general acceptance. The delay of the development committees has caused much dissatisfaction. Their preliminary reports were not made and the conference committee authorized until June. The conferees apparently are determined that the delays which attended the development committees' work shall not characterize their deliberations. We are certain that the profession will appreciate the energy and the disposition that have been shown. We believe, too, that their report will have very careful study. The profession is ready to give its support to a broad, constructive program.

As Others See Us

MR. LEIGHTON'S statement, in a letter to the editor in this issue, that he was hurt by the aspersions cast upon engineers recently by an eminent statesman, can readily be believed. Even the cold reading of words cuts deeply. Are the views correct? Are engineers the "most unresponsive citizens"? Engineers have taken small part in civic affairs; that must be admitted. But that they are more backward than any other group we do not believe. American citizens unfortunately care very little about how their Government is conducted unless their pocketbooks are affected. The business man has responded when tariff revision or other legislation threatened his business; labor responded when there was opportunity to get a wage increase, but, except for the patriotism of the war period, the mass of the people have left the politicians in relatively undisturbed control. But the fact that engineers are no worse than other groups in discharging their civic duties is not a defense for their inactivity. As the builders of the present industrial order, they should long since have become one of the most influential groups of citizens. Fortunately, they are making progress; witness, the subjects discussed at engineering society meetings, as reported in this journal weekly. With the engineers, too, discussion is the forerunner of action. While, therefore, we do not believe that the statesman's words are entirely true, there is enough truth in them to shame our profession. With the perfection of the engineering society organization of the land, which we hopefully look for as a result of the work of the conference committee of the development committees, we should soon remove what criticism is now deserved.

Hydraulic-Fill Dam Construction

WHEN the hearings on the Miami Conservancy District flood-protection project were going on, three years ago, the tightness and permanence of dams built by the hydraulic-fill method was the outstanding feature of interest and discussion. At that time and later, also, the engineers of the district were studying the method very carefully, with a view to deciding whether it should be adopted as standard for the construction of the five great dams of the project. Their tentative conclusions were indicated in the specifications, which provided separately for several different methods of building the embankments, in order to obtain alternative bids and make it possible to select the cheapest method. Subsequently the hydraulic-fill method was adopted for all the dams, and now, following completion of the outlet conduits, active embankment work is in progress at the two largest structures. As the work goes on toward completion, knowledge is likely to be gained that will make the choice of method easier in the future. Heretofore the hydraulic method has been applied almost exclusively in the far West, though there it has been established for a long time by the success of many large dam enterprises. Yet relatively little has been known concerning the engineering facts and underlying data which should control such work. At Miami it is certain that the same careful technical study will be given to the operation of hydraulic method that was given to the prior problems of engineering design. Through this study the great operations whose preliminary stages are briefly described in another column will throw new light on hydraulic-fill work, and raise it the same plane of engineering precision that more familiar methods of construction occupy.

General Staff Bill a Menace to Army's Technical Services

IT HAS taken the war to demonstrate, as no amount of discussion or propaganda could have done, that the military policy of the United States is a matter of concern to professional men—particularly engineers. Experience has shown them that the bulk of the personnel for every staff corps of the Army must come, in a time of national emergency, from the civilian members of the various professions.

American engineers played a big part in the recent war. In the event of future hostilities even greater demands will be made upon them. It is for this reason that the Army bill, drafted by the General Staff and now under consideration by Congress, assumes for them an entirely new significance. They now know that they may be called from civil practice to serve again, and that whatever system of Army organization and administration is now adopted will be the one under which *they* will have to operate. This brings the matter pretty close to home.

A scrutiny of the General Staff bill discloses certain features which are bound to operate to the disadvantage of the Corps of Engineers and other staff departments in which high technical qualifications are required. The main objections are summarized on p. 358 by a correspondent well informed in matters relating to our military establishment. The outstanding defect in the proposed legislation is its clear intent to reduce the Army's staff corps or bureaus, in which is included the Corps of Engineers, to a condition of abject servility to the General Staff; the latter body is vested with practically unlimited powers to regulate the internal workings of departments with the details of which, as a general planning, directing and coordinating body, it should have no concern. Not only would the General Staff aspire to become, simultaneously, a planning and an operating body, but it would also limit promotions to the grade of general officer in such a way as to exclude engineers and other technically trained men from receiving rewards in the form of advancement to high rank for work well done. The bill is clearly drafted in the interests of the "line" officer—the infantryman, the cavalryman or the artilleryman—to the prejudice of the technical man. In fact, there is nothing in the bill to prevent an infantry officer, once having reached the rank of general officer, from becoming Chief of Engineers if the General Staff should so decide.

There is a great need on the part of officers of the General Staff, as well as those of the line, of an understanding of the scope and character of the work which the Army's technical troops and staff corps or bureaus are organized to perform. On this subject the ignorance of many officers in responsible posts seems almost unbelievable. If there was one lesson of all others which the war should have taught our Army, it was the importance of the Engineers in the A. E. F., not only as combat troops but also as constructors in the Services of Supply, where the whole vital system of transportation and storage of food and material was dependent upon Engineer-built utilities in the form of docks, depots, water-supply systems, railway yards and scores of other works. Without these works the armies could not have functioned. It would be a real misfortune, therefore, if Congress should enact into law any measure which would curtail the usefulness of the Engineer arm of the service.

As for the General Staff, it is apparently seeking to establish itself in a position of absolutism. It is clear to any one who has known General Staff officers or has observed the results of their efforts that, in the past, at least, they have not been omniscient. Especially on technical matters do they need advice. In the case of any future expeditionary force, why should we not have a General Staff of which the chiefs of corps or bureaus shall form a part? In the A. E. F., for example, why were the Chief Engineer, the Chief Signal Officer and other heads of important departments located at Tours, the headquarters of the S. O. S., instead of at General Headquarters in Chaumont? These officers were officially the technical advisers of the Commander-in-Chief—from whom, as a matter of fact, they were separated by a distance of several hundred miles, a condition hardly making for the greatest effectiveness. It is true that they had representatives at G. H. Q., but the interests of each staff corps, as well as of the Army as a whole, would have been much better served if their chiefs had been in a position, as members of the General Staff, to assist in shaping policies in accordance with the most efficient use of the organizations they headed.

In any new Army policy, the best interests of the service and of the country will require that the chiefs of the Engineer Corps and other staff departments should be members of the General Staff and not subordinate thereto, as is proposed in this bill. Only so can there be guarantee that these staff departments will function with the greatest effectiveness in future military undertakings.

Field for the Cheaper Types of Highway Pavements

COMMISSIONER Greene of the New York State Highway Department gives in detail in this issue the reason for the strong position he has taken in the public prints and before civic bodies in favor of none but permanent pavements on the roads under his jurisdiction. Commendatory comment has already been made in these columns on the Commissioner's stand—a stand quite opposite to that of some of his predecessors, who, instead of basing their policies on sound engineering grounds, allowed political exigency to rule. Mileage, that the greatest number of constituents might be pleased, even though the cost to themselves should eventually be huge, governed the former policies.

Highway engineers, therefore, will approve heartily the stand that Mr. Greene has taken—in insisting that for trunk-line traffic (and practically all the state roads are trunk roads) permanent pavements should be used. If he continues to have the strong support of the executive, New York State will be his debtor.

In an argument as strong as Mr. Greene's, however, it is likely that sight will be lost of the fact that his condemnation of the cheaper types of surfacing is not universal. He is speaking only of state-road conditions, obviously of those highways which carry either heavy traffic or at least quite a considerable volume, for east of the Mississippi and north of the Ohio only such roads are taken into a state trunk system. Mr. Greene

in his article, it is true, cites Road 430, which, he says, is a secondary road and does not carry heavy traffic. Obviously, he is here using "heavy" as a relative term, the comparison being with such important trunks as the Albany-Schenectady link.

Every one engaged in highway work well knows that the construction of the expensive types is not warranted on the by-ways, on the spurs from main routes to hamlets, and, in general, on what are termed light-traffic roads. Here the macadam and the gravel road, and, even more so, the lighter forms of bituminous construction, still properly hold sway.

To this principle every highway engineer will subscribe, just as he will to the principle of permanent surfacing for the heavy-traffic routes. The difficulties arise in the application of the principles. Where is the lower limit for the heavy-traffic type—or, to put it another way, what is the traffic density, say, in tons per day—which demands that the lighter type be abandoned and the more expensive pavement employed? Figures to enable such a determination to be made are being accumulated. There is value, too, in a close analysis of maintenance costs for different types under different densities of traffic. Traffic counts, as well as the excellent cost-keeping systems now becoming universal, are needed to give the data on which ultimate conclusions must be founded. But until the data are available, the judgment and experience of the engineer will continue to be determining in setting the dividing line between the light- and the heavy-traffic road.

Are the Cement Companies Profiteering?

AT THE direction of the Attorney General of the United States, suit is to be brought against 19 Eastern cement companies on complaint that these corporations have conspired to control—and to increase—the price of cement. The principal points of the complaint will be found in the news section of this issue.

As to the existence and activities of an alleged association (which, by the way, is not to be confused with the Portland Cement Association) this journal has no information. Nor do we feel that the users of cement care whether such an association exists or not, except in so far as its activities cause them to pay an undue price. If the cement companies have profiteered or are profiteering, if they have conspired to set aside the normal laws of competition to the injury of the public, then they should be punished, and restrained from such course hereafter.

Since the armistice there has been much complaint against the high price of cement, just as there has been against the high prices of other building materials—in fact, of all commodities. Not only has the complaint been that the prices are high, but the statements have have been made that the cement companies were profiteering. The only investigation of the question of which we know was made by a committee of the Duluth Engineers' Club. The committee found (see *Engineering News-Record* of Apr. 10, 1919, p. 744) that the "increased price of cement has not been proportionately greater than the average increase on other building materials."

Now that suit is to be brought, however, the "man in the street" will regard the Government's complaint in itself as sufficient evidence that there is a conspiracy on the part of cement companies and that there is profiteering. Users of cement, however, should naturally be better posted than laymen and, unless they have evidence supporting the Attorney General's complaint, should at least await the presentation of evidence before joining in the expected general condemnation of the cement companies.

On the complaint of conspiracy *Engineering News-Record* has no evidence, but on the question of prices there are certain facts open to all that the fair-minded man should bear in mind when reading the Government's complaint. We enumerate some of these, without comment:

1. When cement sold as low as 65c. a barrel at the mill, a fact much stressed by the Attorney General, it was common information that manufacturers were losing money.

2. Cement is a thoroughly standardized product and, accordingly, its price, like that of bread or milk or pig iron, tends through the natural processes of competition to be uniform with all sellers in any one locality.

3. If this law of competition were not operative, the prices quoted by different manufacturers should certainly have been different at the time when there was cut-throat competition, whereas everybody knows that quotations were the same even when the mills were losing money.

4. The price at the mills today is the same as the last price which the Government fixed for the purchase of cement for its own use during the war.

5. Despite the increase in wages and cost of supplies since the armistice, the price of cement has gone down (see *Engineering News-Record's* monthly quotations) and is now on the base of the final figure set by the Government for its own purchases.

6. The Government in fixing cement prices had full access to the cost sheets of the cement companies, and fixed the price so as to allow the manufacturers a 10% profit on their investment. Later investigations by the Government showed that because of increasing costs the actual profit to the cement companies under the Government-fixed price was 7 per cent.

As against these facts, it is also patent that, the price paid by the public during the war being 30c. a barrel above the Government price, the manufacturers made a larger profit on their sales to the public than they did to the Government. Whether this constituted profiteering depends upon a variety of considerations that will undoubtedly come into the open during the course of the suit. Such things are involved as the difference in margins between low-cost and high-cost producers; the return on the investment which is proper in a business such as that of the cement companies, subject as it is to large fluctuation, etc.

The facts detailed above do not, of course, constitute proof that there is no collusion, and the purpose in summarizing the situation is to refresh the memories of those who use cement. Their minds should be clear as to the public facts when they read the Government's complaint. If there be guilt, the people will not hesitate to approve of the punishment and will be the gainers by the Government's action. If the companies are innocent they should welcome the investigation and should be the gainers from the greater confidence in which, as a result of the suit, they will be held by the cement user.

Construction Details of the Lindsay-Strathmore Irrigation District, California

Well-Sinking Operations and Tests—Casings Perforated in Place—Well Collection and Pumping Systems—Cement-Lined Canals—Wood and Asphaltum-Impregnated Felt-Covered Steel Pipe Lines

By E. Court Eaton
Superintendent of the Lindsay-Strathmore Irrigation District, Lindsay, Calif.

THE Lindsay-Strathmore Irrigation District, in the San Joaquin Valley, California, pumps its entire supply from wells, distributes it to consumers through closed conduits and sells the water by meter. The following notes cover some of the more interesting details of well, canal and pipe construction, outlining difficulties met and overcome. They supplement an article on the flume construction published in *Engineering News-Record* of Sept. 6, 1917, p. 449.

The district was organized Oct. 25, 1915. It takes in an area of 15,575 acres, devoted principally to citrous fruits, although olives and grain are also grown. The original bond issue was for $1,400,000 or about $90 per acre. The value of the land and improvements is high and prices of $1000 and $1500 per acre for citrus-bearing orchards are not uncommon. In the year 1915, when the district was formed, approximately 8000 acres of the total had been under cultivation for some years, the water coming from wells sunk on each holding by the growers. As time went on and more land came under cultivation the water plane dropped at an average of about 10 ft. per year and water was increasingly hard to get and more and more expensive to pump. In 1915 the average depth of each well was about 250 feet.

The system finally adopted by the district covered the purchase of an area of 1200 acres of water-bearing land in the delta of the St. Johns and Kaweah Rivers, about 12 miles north of the district. Thirty-seven wells were to be developed in this area and the water was to be carried through three miles of main pipe line and discharged into an open ditch six miles long. At the lower end of this ditch the water was to be given a 160-ft. lift into a concrete flume, also six miles in length, from which pipe lines were to be run to supply a network of steel pipes covering the area of the district. For a portion of the southeastern part of the district, comprising about 2500 acres, at a higher elevation than the balance, a small pumping plant was to be put in, which gave the water a second 160-ft. lift for this section only.

The contract for the system as a whole was let in August, 1916, the contractor in turn letting out certain portions to subcontractors. The work was started in October, 1916, and completed in June, 1918, although the greater portion was completed and in use during the irrigation season which commenced in April, 1918.

Wells—The plan called for the drilling of 37 wells It was estimated that these wells would give 2 sec.-ft. each or 100 miners' inches, with a drawdown of 35 ft. below the ground surface; each well to be approximately 100 ft. deep. This was based on the results obtained from two wells drilled in 1915. The test wells were each 16 in. in diameter, with perforated casing, and, after suitable development, gave over 125 miners' inches, with a depth to water of 35 ft., the normal depth of water then being 6 ft. below the ground surface.

A somewhat different type of construction was employed in the wells drilled under contract, which called for 18-in. plain casing perforated after completion.

Although these wells are shallow, considerable difficulty was experienced in drilling them, as the material below 40 ft. in depth is a coarse sand, mixed with 3-in. gravel and a large number of 6- to 8-in. boulders. The contractor's price for the work was low, and by the time it reached the subcontractor little was left to cover the difficulties nearly always present in well drilling.

Three well rigs were employed. Although double No. 12 casing with heavy shoes was used, by the time a depth of 90 ft. had been reached the heavy boulders had so distorted the shoe and casing that drilling beyond 100 ft. was difficult. However, sufficient water-bearing strata had been passed to give the required overflow.

After a number of wells had been completed and perforated, testing was started, and it became apparent at once that the results obtained from the original two wells were not equalled, except in a few cases, and that the average results were not up to those required, either in quantity of water or drawdown, although the material was substantially the same in all cases. It was evident that the wells had not been perforated as required. The perforator employed was a Mills, originally made for 16-in. casing and adapted to 18 in. by vertical metal strips in such a manner that sufficient support was not given to the casing to prevent distortion. It was found that in most cases the casing had been merely dented. Semicircular collars were put on the perforator to support the casing, and by the use of a longer knife, twice sharpened in perforating each well, better results were obtained, although even with this improvement the results have shown that the casings had not been sufficiently cut. Care had to be exercised not to perforate closer than 10 ft. to the top stratum (about 40 ft. below the ground surface), which is of quicksand, to prevent filling in the well with this class of material.

The wells that had been perforated were recut with the remodeled perforator, and results much better were obtained. It was also demonstrated that a prolonged development of each well was required—in some cases as much as two weeks of continuous pumping and surging before a well would give the required results. In no case did a well collapse due to overperforation but in a number of instances the perforator would strike the junction between a round and a longitudinal joint and the corner of the casing would bend, making it a difficult matter to remove the knife. A tapered end

COLLARS USED TO PREVENT DISTORTION OF CASINGS DURING PERFORATION

put on each end of the perforator, to act as a swedge, eliminated this trouble.

The difficulties encountered in drilling, perforating and testing consumed so much time that it was decided that since a sufficient supply could be obtained for the first irrigation season, the district would later put the wells in the required condition. Matters were further complicated by the fact that the subcontractors were daily losing money on this portion of the work. The number of wells drilled by the contractor was 35, of which six were rejected, due to distorted casing. Taken as a whole, better results would have been obtained if perforated casing had been used instead of the plain casing, although the difficulties encountered in drilling and developing would have been greater. The district has purchased a well rig and now has the completion and improvement of this well system under way, as will be described later.

The average results of tests of 29 of the wells as left by the contractor were as follows:

Depth of each well below ground surface, ft	102
Lineal feet perforated per well, ft	49
Total area of cuts per well, sq.in	1,896
Percent opening of solid casing	6.1
Drawdown per well on test, ft	44.5
Discharge per well on test, sec.-ft	1.66
Drawdown, sec.-ft. per ft	0.0374

The maximum value of second-feet discharge per foot drawdown was 0.12 and the minimum 0.013. From this it appears that the specific capacity is too low, due to incomplete perforating caused by the perforator not going through, and also that sufficient development has not been practiced on each well. A small amount of clay is present, in certain strata, which tends to clog up the perforations, and until this is removed by blowing and surging the best results are not obtained.

Well Pumping Plants—Each well, as completed, has a concrete foundation supporting a vertical deep-well pump with a rated capacity of 1000 gal. per minute at 100-ft. head. The length of the pump below the top of the foundation is 25 ft., with 20 ft. of suction below each pump. A vertical 40-hp. 2200-volt motor is direct-connected to each pump. Two different makes of pump were equally employed. Careful shop tests on these pumps showed very little difference in efficiency, and the guarantees were met or exceeded. The guaranteed efficiency at rated head and discharge was 68%. A speed of 1170 r.p.m. is attained.

Each installation is provided with an individual motor controlled in the pump house, with an ammeter mounted above. Wiring is brought in through conduits running to a line pole outside the building, with a pole-top switch on this pole to cut off power from the building in case of repairs. All wiring is lead-covered cable in conduit. Each pump installation is housed in a wood building 10 ft. square with a tower to facilitate pulling the pumps.

Power is supplied from an outdoor substation at 2200 volts, by the power company, and distributed at the same voltage to each well by transmission lines built by the district. Overload and no voltage protection is provided in each station by relays.

Each pump is provided with a gate valve, a check valve, a pressure gage and an air gage, by means of which — by introducing air pressure — the depth to water can be measured conveniently and accurately. These pumps work directly through a wood-pipe system to a canal 3¼ miles distant.

Well Collector System—Each well discharges directly into a network of 14- to 44- in. wood pipe, and these pipes discharge into two 48-in. wood pipe laid side by side which empty into the low-level canal, the intake to which is approximately 58 ft. above the average ground surface at the wells.

All wood pipe of 14- to 24-in. diameter is machine-banded, and above this continuous stave redwood pipe is used. Heads vary from 20 to 80 ft. The pipe has 2 ft. of cover except where crossings are made on bridges over rivers and canals.

Laying pipe lines underground in an area where the normal water plane stood only 4 to 5 ft. below the surface, at a season of the year when sudden floods were liable to inundate the whole area, was not easy, and two floods were experienced with resulting flotation of large sections of pipe. Time was an important element, and the difficulties in relaying this pipe with the higher water plane consequent on the floods seemed almost insurmountable. Some pipe had to be laid with water in the trench. The second flood followed suddenly after the damage done by the first flood had been almost repaired.

The location of the work in a water basin such as this made labor hard to get and harder to keep. An undesirable element of labor—known as the I. W. W.—crept in, which, after delaying the work as much as was in its power, called a general strike by intimidation and placarded the district with sabotage posters and various painted signs. This strike extended to the whole work at a critical time, when more than 400 men were employed, and it was necessary to have an armed guard with each gang to induce the better class to return to work. The elimination of the undesirables was finally achieved, but even after this was done, and the pipe lines were completed, the results of their work remained, as was evidenced when water was turned into the line under pressure. Numerous leaks due to insufficient cinching showed up in a number of places. They were being repaired, but leaks broke out in other spots. Finally, the subcontractor dug out the whole 10½ miles of continuous stave pipe, recinched it and buried it again. In a number of locations, bands had been left barely tightened up. The difficulties attendant on doing this in a wet season, through a section of the country not only not in the irrigation district but hostile to it, can better be imagined than described. A great deal of credit is due to the pipe company for the sportsmanlike manner in which it attacked the work after the repeated setbacks experienced. The result of this has been a pipe line which, beyond a few minor leaks at junctions with steel fittings, has given no trouble.

A relief tower is installed on the junction of the well pipe system with the 48-in. mains, to relieve the pipe of surges due to power shutdowns.

Low-Level Canal—Six miles of an old earth ditch skirting the foothills north of the district was purchased and enlarged to give a bottom width of 6.33 ft., a depth of 3½ ft. and 1 : 1 side slopes, lined. The material in which the canal was located was adobe with a good deal of loose rock, and the enlargement required an excavation of 104 cu.yd. per 100 ft. About three miles of this was excavated with teams and slips, which gave much the better appearance. The remaining three miles was excavated with a steam shovel operated from mats laid across the ditch. With the relatively small amount of excavation to be made, numerous pockets from 1 to 1½ ft. below grade resulted and necessitated

expensive work in replacing earth and trimming. Thorough wetting and tamping were insisted upon.

The lining was 1 in. thick, shot on with cement guns, using a 1 : 4½ mixture of cement and sand, with 10% by volume of cement in lime added. It is reinforced with No. 18 poultry wire. The lining contained 18.23 sq.ft. per lineal foot. An average day's run was 175 ft. per ten hours.

The actual quantities of materials used during May,

TRANSITION FROM 48-INCH WOOD PIPE LINES TO LOW-LEVEL CEMENT-LINED CANAL

1917, which was a fairly representative month, were:

Lineal feet lined	5,500
Square feet lined	100,265
Cement used, sacks	3,386
Lime used, sacks	150
Fuel oil used in compressor, gal	763
Lubricating oil used in compressor, gal	31
Payroll for month:	
Foreman	$191 21
Engineer	88 33
Nozzleman	88 33
Helper	70 65
Gun operator	88 33
Laborers mixing	351 65
Cost of Materials	
Cement, per barrel	$2 75
Reinforcing wire, per 100 square feet	.72

At the end of each day's run, a wood dam was placed in the canal and water immediately admitted to the completed section, so that within 48 hours after construction the canal was filled two or more feet.

The greater part of the work was done during the hottest time of the year, with temperatures ranging from 100 to 115° F. During the daytime exposed sections of lining were sprinkled with water.

The canal terminates at the lower end in a reservoir with a capacity of ¼ acre-ft., located at the main pumping station. Provision for overflow is made by means of a siphon spillway discharging through 2300 ft. of 30-in. concrete pipe into a waste reservoir, from which it seeps into the ground.

Main Pump Station—This station has a capacity of 85 sec.ft. It takes water from the lower end of the low-level canal, and gives it a 160-ft. lift into the intake to the high-level flume.

High-Level Flume—This is six miles long and carries the total flow for the district, distributing it through outlets into the pipe distributing system. The flume is laid on a bench cut from the hillside, the excavation for which averaged 90 yd. per 100 lin.ft. The excavation was completed six months in advance of the flume construction, thus allowing fills to settle thoroughly. The flume is 5.75 ft. wide at the bottom, 4 ft. deep, laid on a grade of 5 ft. per mile. It is of reinforced gunite construction with 2-in. sidewalls, the whole surmounted by a 4 x 6-in. rectangular beam, the beams on each side being tied together with ¾-in. bars. The forms consisted of 1-in. tongued-and-grooved flooring, kept thoroughly oiled, braced with 2 x 2-in. bracing. A set of 700 ft. of forms, with slight repairs, lasted the whole job. The side walls were shot on in two layers, the first being 1½ in. thick, up to the reinforcement. After about 15 min. the final ½ in. was applied. The reinforcement was held the required distance from the inside face with spacing bars. These bars were removed, as sufficient concrete had been shot on to insure the mesh having its proper position in the structure.

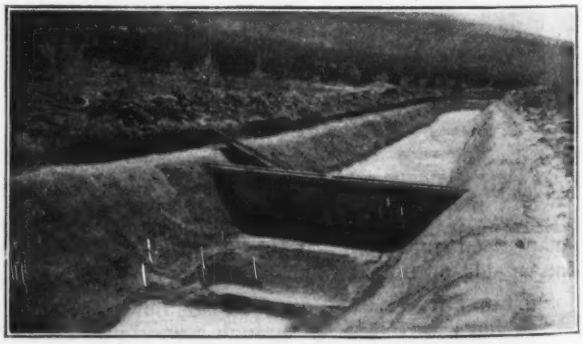
THE 48-INCH WOOD PIPE LINES AFTER FLOODING

An attempt was made to gunite the 4 x 6-in. beam on the top without forms, but it was found that unless this were done in several layers with sufficient time interval to allow partial settling, the mass was so heavy that it sagged forward and broke away. Small forms were placed above the side walls immediately after they had been completed, and the rebound from guniting, which had been caught on canvas, was used in pouring these beams. Ten per cent of cement was added to this material before placing.

For the most part, the flume was constructed during hot weather, with temperatures from 100 to 125° Fahrenheit.

Immediately after the construction of a section of side wall, burlap was hung from the beam over the sides and the walls were then kept thoroughly wetted for 24 hours. After this period, the flume was kept filled with water. The mix was 1 part cement to 4½ of sand, with lime in the proportion of 10 per cent. of the cement added.

The average rate of progress was 140 lin.-ft. per day, with a construction crew as follows:



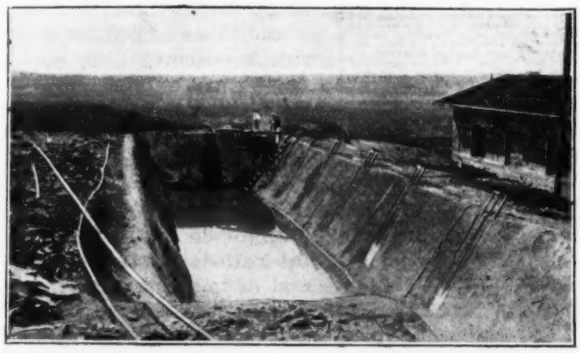
DAM FILLED EACH RUN OF CEMENT LINING

1 [illegible]man	$5.00
1 [illegible]man	5.00
1 [illegible]man's assistant	3.00
1 [illegible]pressor operator	5.00
1 laborer shovelling sand	2.75
1 laborer screening	2.75
4 laborers mixing and turning over at $2.75	11.00
10 laborers finishing grade and wrecking forms at $2.75	27.50
3 carpenters setting forms at $4.00	12.00
4 men placing steel at $2.75	11.00
Total per day	$85.00

For the first two days after the flume was filled with water some "sweating" was noticeable but in the course of a few days this entirely disappeared.

Eleven outlets along the flume at different points feed the network of distributing pipes, and at the lower end of the flume a small forebay is constructed from which two main pipes lead—one a 30-in. steel main to supply the larger portion of the district through branch lines, and the other a 30-in. main to the El Mirador section. Venturi meters are provided in each of these lines to measure the discharge. The forebay has a siphon spillway discharging through 2400 ft. of 30-in. concrete pipe, into a creek bed.

Distribution System—The distributing system from which the grower obtains his supply consists of about 100 miles of slip joint, riveted steel pipe. The joints are 4 to 5 in. long, depending on the size of pipe. The



FOREBAY AT MAIN PUMPING STATION

steel employed was No. 16-gage for pipes from 4 to 16 in. in diameter; 14-gage for 18 to 26 in.; 12-gage for 28 to 30-in., and 10-gage for 34- and 36-in. pipes. The static heads run up to 75 feet.

To resist the action of the strong alkali soil in which the pipes are buried, they are covered with asphaltum-impregnated felt. The pipes are first given an initial dip and then redipped immediately before wrapping. Hot dip is also fed onto the covering as this is wrapped on under tension by machine. The wrapping is wound spirally on the pipe and lapped.

As the life of the pipe is largely dependent on the covering, particular attention was given to it. High-grade felt was impregnated with an asphalt mixed with certain gums to raise the penetration to 80. The finished product had a weight of 40 lb. per square, divided as follows: Felt, 10 lb.; saturated solution, 12; coating front, 12; coating back, 6. Rags averaging 10½ lb. per square went into the manufacture of this covering. The outside of the covering received a coat of flaked mica to prevent the adobe earth from adhering to the pipe and stripping the covering.

The dip was inspected and tested with care. Specifications called for this to have a penetration of not less than 0.15 cm. in 5 sec., using a No. 2 needle and 100-grain weight, or 77° by the method of the American Society for Testing Materials; melting point to be not less than 165° by the "hook-and-cube" method.

Pipes were laid by heating the butt ends and driving while hot, the joint being covered in the field with hot dip and felt covering; all pipes were buried with a

METHOD OF INSTALLING VALVES AND FITTINGS

2-ft. minimum cover over them. Trenching was done by machine, and pipes were carefully tamped and backfilled by hand. The pipes were all tied together as a network, and 155 valves were used for sectioning purposes. Valves were all "ventured"; a valve 2 in. smaller than the line was installed by means of two steel reducers.

A 30-in. main runs from the end of the flume, a distance of 4½ miles, discharging into a balancing reservoir. At a distance of ½ mile from this reservoir, suction pipes are brought from this main to the boosting station that supplies the El Mirador District of 2500 acres. This station contains three pumps aggregating 9½ sec.-ft. capacity. The pumps discharge into a small canal, known as high-level canal No. 2, five miles in length, which feeds the El Mirador pipe lines.

The balancing reservoir thus floats on the line and takes up fluctuations in flow, storing up at one time and being drawn upon at another. It has a capacity of 18 acre-ft. The canal has a 2-ft. bottom, is 1½ ft. deep, laid on a grade of 5 ft. per mile, and is gunite-lined like the low-level canal. The construction of this canal did not present any particular difficulties, except that the work had of necessity to be done during the winter months with the attendant troubles due to long hauls over adobe roads and delays occasioned by wet weather. The principal difficulty experienced was due to clogging by the damp air of compressor hose when guniting. In one case where a section had to be completed under adverse weather conditions it was necessary to keep fires burning around the air pipe to dry out the air.

Air Valves and Blowoffs—Air valves of the "air-and-vacuum" type were installed at principal elevations and dead ends. About 200 of these were put in. For the most part ½-in. valves were used, but a number of 1- and 2-in. were placed on the larger pipes. At low points 4-in. blowoffs were placed to drain the pipe lines.

A second article will deal with operation during the first or 1918 irrigation season, giving also some further notes on construction, and describing the meter system, which includes both master and consumers' meters.—EDITOR.

Classification of State, County and Municipal Salaries

Engineering Council Committee Formulates Scheme as Basis for Inquiry Into Needed Changes in Compensation of Engineers

AS A part of its investigation, the state and municipal section of Engineering Council's committee on classification and compensation of engineers is sending out a questionnaire to 161 state and city engineers, as noted in our issue of Aug. 14, 1919, p. 340.

Included in the questionnaire is a classification of engineering positions, reproduced herewith. This classification follows a general plan adopted by the full committee in order to facilitate comparisons among all branches of engineering service; it has been worked out in detail for state, county and municipal service in coöperation by the section committee and a special committee of the Municipal Engineers of the City of New York.

The latter committee included W. W. Brush, deputy chief engineer of the Department of Water-Supply, and five other engineers in various city or borough departments. The section committee of Engineering Council consists of Arthur S. Tuttle, deputy chief engineer of the Board of Estimate and Apportionment, New York City; F. W. Cappelen, city engineer of Minneapolis; and M. M. O'Shaughnessy, city engineer of San Francisco.

Classification of Engineering Positions in State, County and Municipal Service

Title	General Description of Position	Duties	Qualification
Consulting Engineer	On special duty of responsible character requiring special qualifications and initiative.	Giving expert advice on engineering work of the most important character, involving critical examination and report on questions of cost, design, specifications, construction, maintenance, operation or engineering policy.	Such training in civil, mechanical, electrical, sanitary, or other engineering branches as is evidenced by a professional degree granted on the completion of a standard course of instruction in an engineering school of recognized standing, with experience of not less than four years in the duties of Engineer and broad experience in the branch of engineering involved in the work concerned. If a professional degree has not been granted by an engineering school of recognized standing, an engineering experience of not less than fifteen years may be considered to qualify for this position, provided that the record of work performed gives substantial evidence of an engineering knowledge and ability of the highest order.
Chief Engineer, State Engineer, City Engineer, Deputy Chief Engineer, Deputy State Engineer, Deputy City Engineer.	Chief administrative officer having full charge of organization including determination of policy.	Assuming entire responsibility as the engineering executive for reports, estimates of cost, design, specifications, construction, maintenance or operation of engineering works or projects either that are to be constructed or are to be operated.	Such training in civil, mechanical electrical, sanitary, or other engineering branches as is evidenced by a professional degree granted on the completion of a standard course of instruction in an engineering school of recognized standing, with experience of not less than four years in the duties of Engineer and broad experience in the branch of engineering involved in the work concerned. If a professional degree has not been granted by an engineering school of recognized standing, an engineering experience of not less than fifteen years may be considered to qualify for this position, provided that the record of work performed gives substantial evidence of an engineering knowledge and ability of the highest order.
Engineer	Chief of major subdivision in responsible charge of large unit.	Supervising work requiring executive ability. Furnishing expert or critical engineering advice of a high order for executive action.	Such training in civil, mechanical, electrical, sanitary, or other engineering branches as is evidenced by a professional degree granted on the completion of a standard course of instruction in an engineering school of recognized standing, with experience of not less than three years in the duties of Senior Assistant Engineer. There may be substituted for a professional degree such training in engineering as would qualify the incumbent to properly perform the duties of this position.
Senior Assistant Engineer	Chief of intermediate subdivision in responsible charge.	Exercising independent engineering judgment and assuming responsibility in studies and computations necessary to preparation of plans, designs, reports, etc. Supervising work of small units in engineering organization.	Such training in civil, mechanical, electrical, sanitary, or other engineering branches as is evidenced by a professional degree granted on the completion of a standard course of instruction in an engineering school of recognized standing, with experience of not less than two years in the duties of Assistant Engineer. There may be substituted for a professional degree such training in engineering as would qualify the incumbent to properly perform the duties of this position.
Assistant Engineer	Chief of minor subdivision	Taking charge of designs, surveys, or construction work involving considerable responsibility on small engineering projects or minor work on large projects.	Such training in civil, mechanical, electrical, sanitary, or other engineering branches as is evidenced by a professional degree granted on the completion of a standard course of instruction in an engineering school of recognized standing, with experience of not less than one year in the duties of Junior Assistant Engineer. There may be substituted for a professional degree such training in engineering as would qualify the incumbent to properly perform the duties of this position.
Junior Assistant Engineer	On general duty under direction but requiring special education and training and the use of initiative and originality.	Using surveying, measuring and drafting instruments, engineering tables and diagrams. Computing and compiling data for designs, reports and records. Inspecting or investigating minor details of engineering work and materials. Keeping notes of field work.	Such training in civil, mechanical, electrical, sanitary, or other engineering branches as is evidenced by a professional degree granted on the completion of a standard course of instruction in an engineering school of recognized standing, but not necessarily any experience in the practice of engineering, other than that which is incident to the attaining of such qualifications. There may be substituted for a professional degree such training in engineering as would qualify the incumbent to properly perform the duties of this position and would be a suitable foundation for the advancement of the incumbent to higher positions in the professional engineering service with further training in engineering.
Senior Draftsman	On general duty under direction but requiring special education and training and the use of initiative and originality.	Directing work of a drafting squad. Supervising preparation of maps, plans, etc.	
Draftsman	On subordinate duty requiring special education or training but not requiring special originality.	Preparing general working drawings where design is furnished. Plotting of notes and preparation of maps. Design of simple structures. Making computations and compiling data for reports, records, etc. Checking plans, surveys, etc.	
Junior Draftsman	On subordinate duty not requiring special education, training or originality.	Tracing and lettering maps and plans. Making simple drawings from sketches and data. Making minor calculations.	
Chief Instrumentman	On general duty under direction but requiring special education and training and the use of initiative and originality.	Directing work of field party on surveys or construction. Keeping notes, record of work, etc. Supervising construction or repair work. Directing and leading in the work of computing surveys, estimates, etc.	
Instrumentman	On subordinate duty requiring special education or training but not requiring special originality.	Running surveying instruments and adjusting and caring for same. Computing surveys, estimates, etc. Inspecting incidentally construction or repair work.	
Rodman	On subordinate duty not requiring special education, training or originality.	Running tape or levelling rod. Performing other miscellaneous subordinate duties in survey party in field or office, as directed.	

ENGINEERING COUNCIL'S CLASSIFICATION OF SALARIES AND POSITIONS FOR GOVERNMENT ENGINEERS

Network of High-Tension Transmission Lines for Spain

CONSTRUCTION of a national network of high-tension transmission lines, linking all the industrial centers of Spain with the larger waterfalls and coal mines, has been proposed to overcome the drought and the coal shortage which now hinder economical development of power.

According to George F. Paul, in an article in *Electrical World*, a special commission has been formed to study the problem, and has already listed 2,000,000 available horsepower from waterfalls capable of producing more than 2000 hp., each. The plan is to link all the available sources with the system and allow all those who desire to feed into the lines to do so, thus making the national system the general distributing agency.

Those utilizing the service will be required to furnish power at 50 cycles and probably 120,000 volts. In places where drought will affect the hydro-electric plants, it is planned to supplement them with power produced by low-grade coal which it is not economical to mine for general commercial purposes. The law will require the system to utilize for the most part electric power that is of hydraulic origin.

For financing the proposed system, the commission recommends that the enterprises which utilize it shall pay an annual fee representing the cost to the state in interest for obtaining the necessary capital, plus the cost of the care and maintenance of the system.

The state will fix the rates that are to be charged to the consumer for the service rendered.

High Cost of Maintenance of Light Macadam Highways

Large Sums Expended Annually Merely Keep Up Improved Roads—Narrow Roads More Expensive Than Wide

By Frederick Stuart Greene
New York State Commissioner of Highways

In answer to an inquiry resulting from the published statement that only concrete pavement would be built hereafter in New York State, Commissioner Greene has submitted the following communication.—Editor.

REGARDING recent articles that appeared in the daily press relative to high maintenance costs of water-bound and the lighter types of bituminous macadam roads, I desire to answer somewhat at length. The country is beginning a new era in highway construction, and I feel that anything that can be said to bring before engineers the danger of designing and constructing highways that will not stand up under modern traffic conditions should be said with emphasis and said now.

Upon taking office as Commissioner of Highways, I was astonished to find how large a sum the state is expends yearly merely to keep its improved roads in repair. When I was informed that the department had $5,500,000 to spend during 1919 upon the maintenance of 7400 miles of completed construction it seemed to me a large sum, but when I was told by our nine division engineers that this appropriation, which allows $743 per mile for both old and new roads, gave none of them enough money to put all of their roads in first-class condition, I could hardly credit their statements. This led me to investigate, and the deeper I went into the history and records of our highways the more astonished I became. If, before I had seen these records for myself, anyone had told me what the maintenance charges totalled in a few years on some of our roads, I would not have believed the figures. That the departmental records are correct, however, no one familiar with the system of accounts as conducted by our auditor, Sephrine D. Gilbert, can doubt. Mr. Gilbert has served the department as auditor for nine years, and has witnessed the coming and going of six different administrations.

Examples of Higher Maintenance on Roads

Here are some examples, taken from many roads upon which the maintenance charges have caused me serious thought:

Road No. 176 is a 2.31 mile stretch on the highway between Albany and Schenectady. It was built in 1906 of water-bound macadam, and cost $22,978.44. By Jan. 1, 1919, it had been in use for 13 years, and to maintain it and rebuild it during this period the state was forced to expend $95,721.38, making this road cost the state a total of $118,699.82.

Road No. 743, Babylon-Bay Shore, on Long Island, is 4.08 miles in length. It was built of macadam in 1908 at a cost of $44,600. The maintenance charges for 10 years amounted to $68,338.49. Here is a road which was a cheap one to build originally, but which in 10 years has cost the state a total of $112,938.49.

Road No. 589, Nevis-Blue Stores, in Columbia County, was built as a macadam highway, 3.77 miles long. It was completed in 1908 at a cost of $28,200. In 10 years the maintenance and reconstruction had amounted to $73,386.76, giving a total cost to the state of $101,586.76.

These three roads are on through routes and consequently carry heavy traffic, but our records show that there are many roads not on through routes upon which it is necessary to pay an excessive cost for maintenance. In many instances these are narrow roads, 14 ft. and even 12 ft. in width, where the wheels of traffic are constantly running in the same ruts, and the maintenance on such roads would indicate that here again is a false economy—that though the first cost of narrow pavements might seem a saving to the state, they are in reality a liability. For example, we will take road No. 438. This is a north and south connection running from the highway between Utica and Syracuse northerly to within a few miles of the city of Rome in Oneida County. It is clearly a secondary road, and traffic upon it is not heavy. This highway was accepted Oct. 1, 1908. It is 7.1 miles in length, and for the greater portion is but 14 ft. in width. It cost originally $83,000. To Jan. 1, 1919, the state had paid out for maintenance and reconstruction on this road a total of $88,910.57, which is at the rate of $1,252 per mile

In the western part of the state, Highway No. 853, another secondary road, running north from Batavia in Genesee County, a distance of 4.07 miles, was originally a water-bound macadam, completed in January, 1911. Here is one of our narrow 12-ft. pavements that cost the state the comparatively small sum of $16,700.86 to build, but which at the end of but eight years' service had cost to maintain $26,050.54, or $800 per mile per year. This highway does not connect two towns, it is merely a spur road running through a farming country, to end a mile south of the hamlet of Elba, and is so narrow that in England or France it would be called a lane.

Highway No. 586, beginning just west of Batavia, is on a through route. Built with a 16-ft. pavement of water-bound macadam, this road is 5.58 miles long, was accepted in the autumn of 1908, and cost $46,815. From Jan. 1, 1909, until Jan. 1, 1919, ten years, its maintenance charges totalled $71,607.24, or at the rate of $1280 per mile per year.

Highway No. 5145 is on the same route to the east of Batavia. This is a new bituminous-macadam road, accepted in December, 1912; it was built with a 6-in. sub-base, finished with a limestone surface and asphaltic binder. It is 4.44 miles in length, 16-ft. pavement, and cost $44,332.95. In its first six years of service it has cost the state $11,633.46 to maintain. This is one of our good macadam roads, constructed as well as we know how to build by the penetration method, but it has cost $437 per mile per year to maintain.

Cheaply Built But Expensive Roads

With the exception of highway 5145, these are examples of some of our cheaply built but expensive highways. There are many more that could be cited to show the false economy of building roads which have the one virtue, if it can be called a virtue, of low first cost. Below is submitted a list of roads which will give a better average of the cost and maintenance charges of cheaply built roads. These roads are taken from 18 different countries in the state; all of these roads were accepted in 1912, and the charges per year.

are taken only to Jan. 1, 1919. For our purpose of study, therefore, they have been in service 6½ years, and a road of this age can hardly be called old.

I have not been Commissioner of Highways long enough and I have been so busy since taking office, that I have not had sufficient time to make a thorough search into this matter of maintenance of the different types of pavements. But I have discovered enough to convince me that the life of a water-bound or a light bituminous-macadam pavement averages about seven years and can not be reckoned beyond 10 years. Our roads are built for the most part from 50-year bonds, and it does not require a financial genius to see that if we continue to construct and reconstruct roads five times before they are paid for once such a policy will inevitably lead to financial embarrassment.

COST AND MAINTENANCE OF MACADAM ROADS IN NEW YORK STATE

County	Road No.	Miles	Construction Cost	Maintenance Cost
Genesee	5090	4.47	$54,395.45	$75,081.76
Montgomery	5126	2.24	31,125.53	58,680.07
Jefferson	625	5.37	65,200.70	36,892.55
Livingston	5142	4.05	45,105.16	32,357.10
Onondaga	555	7.77	95,867.77	49,402.04
Ontario	5081	5.26	76,282.93	51,961.49
Otsego	708	4.60	54,457.48	23,440.42
Rensselaer	5107	.40	8,660.09	4,437.09
Rensselaer	680	3.92	39,211.46	21,910.29
Suffolk	5008	3.55	53,551.56	29,142.66
Suffolk	5111, 5112	10.01	100,924.06	74,888.14
Tompkins	5043	2.53	34,339.72	28,158.29
Wyoming	892	1.43	16,006.95	8,623.73
Dutchess	5092	4.15	51,792.70	41,772.67
Fulton	5096	.64	9,779.84	5,603.59
Herkimer	263	5.52	69,283.36	39,611.56
Nassau	5106	2.46	29,511.25	23,876.91
Oneida	839	1.21	13,861.57	9,764.43
Steuben	904	1.64	16,952.59	9,219.31
Steuben	907	4.13	52,156.06	30,471.08
Steuben	5130	1.16	10,891.44	9,887.63
Wayne	919	3.87	26,515.09	37,062.18
		80.48	$955,872.76	$702,244.99

Condition Results From Unforeseen Conditions

I do not criticise my predecessors for their action in building these types. When New York first began its program of road improvement the water-bound road was the generally accepted type outside of city limits. Then when the automobile arrived and its tires began tearing away the road surface the department tried other types. But, do what they could, it seemed impossible to keep pace with the ever-increasing wear and the heavy and more destructive traffic that our roads were forced to carry.

The advent of the motor truck and its rapid growth have revolutionized traffic conditions. No one could have foreseen its remarkable growth. So I repeat that the building of these types of roads in the past was not an unpardonable error. But I do hold that a commissioner who has witnessed this growth of motor trucks, and has not sufficient vision to know that he must build permanent roads, even though their first cost is high, is not the right man for the place. Rapid as has been the development in motor trucks, they are still but at the threshold of their usefulness. The numbers of these vehicles will continue to grow in the future, and will grow with greater rapidity than it has in the past. The time is here when we must build for the future, and strive by every means to construct the most permanent road that engineering knowledge can devise.

Referring again to the records of this department, they show us that during the past four years our 208 miles of first-class concrete roads have cost $108 per mile per year for maintenance, and this cost is due largely to mistakes made with expansion joints, resulting in some comparatively expensive repairs, caused by sections of the pavement being destroyed by expansion. We have concrete roads, where expansion joints were placed as we now know how to place them, which cost us less than $50 per mile per year for maintenance. We have concrete roads on main traveled routes in this state that have been down five years and show so little wear that the broom marks, left as a finish to the surface, are still on that surface.

Our modern concrete roads, except for cracking, due to frost heaving, are as good today, so far as wear is concerned, as they were the day after their acceptance by the state, and we believe that we can now build *reinforced* concrete roads which will last certainly for 25 years, and all indications would point to a longer life. On the other hand, 2451 miles of water-bound macadam in this state have cost during the past four years $911 per mile per year to keep them in condition; this cost does not include reconstruction of a more permanent type, and these maintenance charges, it should be remembered, are based on lower prices for both labor and material than we have today.

Advocates of macadam roads have recently stated that in spite of their high maintenance charges they are, nevertheless, the most economical type when interest on first cost is considered. These advocates admit that they have not complete data as yet on reconstruction costs, but they say generally that the reconstruction of a concrete pavement is necessarily more costly than that of a macadam pavement. Aside from the fact that they have omitted to mention the longer life of the concrete pavement, their statement that reconstruction of a concrete road is more costly is open to question. Taking an average of our roads throughout the state, it has been found necessary to resurface the water-bound and bituminous-macadam (penetration method) roads at the end of about seven years of service. On the other hand, it is conservative to suppose that first-class concrete roads as now laid will last at least 15 years before resurfacing is necessary.

Cost of Bituminous Roads

The cheapest reconstruction that we now do on macadam roads is to lay a new two-course bituminous-macadam pavement over the old road. At present prices this costs an average of $16,700 per mile for a 16-ft. pavement. In Wayne County, Michigan, an old concrete road has been successfully resurfaced by placing a new reinforced-concrete top of 3-in. thickness. Let us suppose that we would wish to resurface with a 4-in. reinforced top, then a mile of 16-ft. pavement, requiring 1043 cubic yards of concrete for such resurfacing at $16 per cubic yard (which is not a low price) would cost $16,688. If these figures and premises are correct they show that the resurfacing of a concrete road at the end of 14 or 15 years is half the cost of the double resurfacing of a macadam road apparently necessary during the same period.

Further than this, a bituminous-macadam road requires re-oiling about once in every three years, to replace the volatile ingredients of the asphaltic binder which have evaporated. At the present time, to oil and cover the oil with small stone or screenings is costing from $475 to $500 per mile on a 16-ft. pave-

ment. We are dealing only with dollars and cents in this article, but it is not out of place to call attention here to the inconvenience of traveling a road which at the end of 15 years has had to be oiled twice and resurfaced twice, while the concrete road may have to be resurfaced once and oiled not at all.

In considering the relative total costs of a highway, including interest charges on first cost, we will deal only with the pavement, for the grading, culverts, etc. would cost the same, regardless of the type of road constructed. The following estimates are based on a pavement 16 ft. wide: For the concrete road, a section 6 in. thick at the sides and 8 in. thick in the center is taken. For both the water-bound and the bituminous-macadam pavement a 6-in. sub-base of field stone, with a 3-in. top course of broken stone, is taken.

At present prices the average cost of a water-bound pavement of this construction is approximately $17,500 per mile; a bituminous-macadam pavement, $18,900, and the concrete pavement, $25,812 per mile. This last cost is derived by multiplying 1912 cub. yd. of concrete by $13.50 per yard.

Maintenance records in the department show that to keep pavements in first-class condition, the water-bound macadam roads have cost approximately $950 per mile per year, bituminous-macadam approximately $600, and concrete roads of modern construction are costing less than $100 per mile per year.

Remembering that road history shows that the average life of a water-bound or a bituminous-macadam pavement is seven years in this state, that after seven years of present traffic conditions these types of pavements have to be reconstructed, we will, therefore, consider the total cost of the different pavements for that period:

	First Cost	4 Per Cent. Interest 7 Years	Maintenance 7 Years	Total Cost
Water-bound macadam	$17,500 per mile	$4,900	$6,650	$29,050
Bituminous-macadam..	18,900 per mile	5,292	4,200	28,392
Concrete.....	25,812 per mile	7,227	700	33,739

These figures show that by the time the two types of macadam pavements are worn out and in need of reconstruction, at a cost of approximately $16,000 per mile, the concrete pavement, which should be good for at least seven additional years, has cost only $4700 more than the cheapest type of highway that any state should now build.

From all available data, there is no doubt that at the end of 8 or 10 years of service, depending upon the amount of traffic, the concrete pavement is the most economical one that can be constructed.

These are but some of the reasons why I advocate a more permanent road than we have been building in the past, and it is my belief that, considering the new problems of traffic that we have to solve, the most practical pavement for a highway today is the one built of concrete.

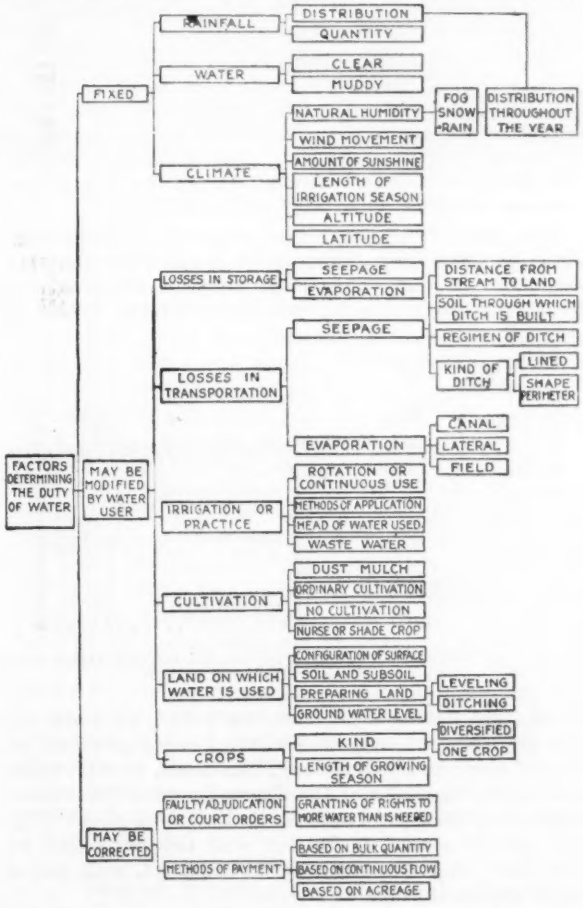
Large Francis-Type Turbines

Francis-type turbines rated at 22,500 hp., and operating under a head of 800 ft., are to be installed at the Kern River No. 3 hydro-electric plant of the Southern California Edison Co. These wheels are said to be the highest-head turbines that have ever been built. The generators are of unusual design, in that they will furnish either 50-cycle or 60-cycle energy, two different systems being served.

Factors Determining the Duty of Water in Irrigation

By H. F. Robinson
Supervising Engineer, United States Indian Irrigation Service, Albuquerque, N. M.

MANY factors enter into the duty of water for irrigation. While they are well known to engineers dealing with the subject, yet their arrangement in diagrammatic form may be useful as a check list. This arrangement was first prepared by the writer for



CHECK DIAGRAM FOR DUTY OF WATER IN IRRIGATION

use in the court-room when acting as a witness in a suit for the adjudication of water where the duty of water was one of the vital points.

For the benefit of those not familiar with the subject, it may be noted that, according to Mead, "the duty of water in irrigation is the area of crop which can be matured with a given volume." As usually expressed by the depth of water used, it is the reciprocal of the above and may be stated as "the amount of water, expressed in depth, applied during any irrigation season, necessary to produce the normal fruitage of any particular crop."

Largest Amount of Concrete Road Per Capita

According to the Portland Cement Association, Utah enjoys the distinction of having contracted since Jan. 1, 1919, the largest amount of concrete pavement per hundred thousand population contracted for by any state.

Block Yard Cheaply Improvised From Old Equipment

Low Bid and Rising Costs Met by Cutting Plant Investment—Output Maintained by Intelligent Oversight

PRECAST concrete blocks for revetting the widened Miami River at Dayton and Hamilton, Ohio, are being produced at a rate of 1200 blocks per day by a force of 20 men at a field factory now at Dayton, but which will be transferred to Hamilton later this season. This output of 60 blocks per man per day amounts to nearly 2 cu.yd. of concrete mixed and molded per man per day. By intelligent use of equipment on hand, and ingenuity in fabricating molds and special machines for the work, the contractor is realizing a profit at an exceedingly low contract price. His product is passing the rigid inspection of the engineers of the Miami Conservancy District with very few rejections.

Portions of the widened river channels at Dayton and Hamilton will have their banks paved with concrete. As shown in Fig. 1, the steep slope of the levee will be paved with a slab of reinforced concrete molded in

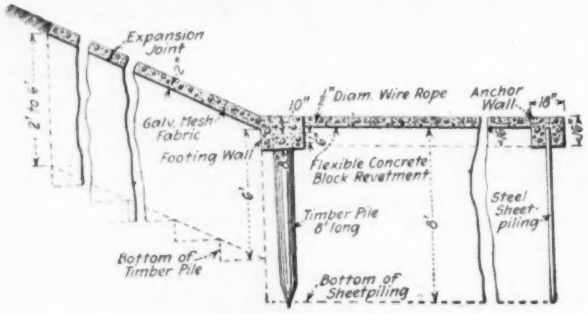


FIG. 1. LEVEE SLOPE AND FORESHORE REVETMENT FOR MIAMI RIVER FLOOD CHANNEL

place. The flatter slope from the toe of the levee out into the water will be paved with a flexible pavement of precast concrete blocks strung, like beads, on wire rope. About 400,000 blocks of the dimensions and form illustrated by Fig. 2 are required, and of these about 175,000 will be placed at Dayton and the remainder at Hamilton. A 1:2½:4 mixture is employed, with gravel as the coarse aggregate.

The site for the block yard at Dayton is on the river bank. Here the dragline excavators which are widening the channel deposited a stock of gravel, as indicated by the diagram plan, Fig. 3. The preparation of the raw aggregate consists of crushing, washing and screening. A small derrick operating a clamshell bucket handles the gravel from the stockpile to a hopper over a jaw crusher set to 2-in. size. From the crusher the material is taken by a bucket elevator to the washer and

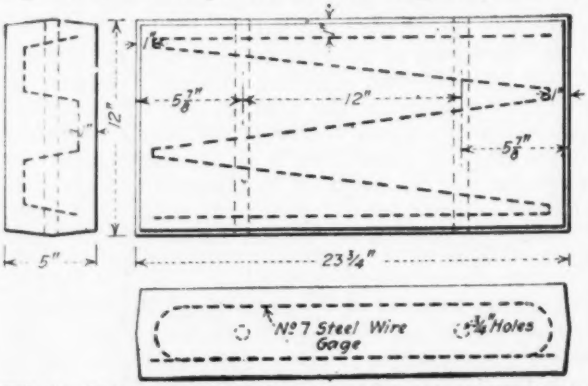


FIG. 2. CONCRETE BLOCKS FOR FLEXIBLE REVETMENT ON FORESHORE

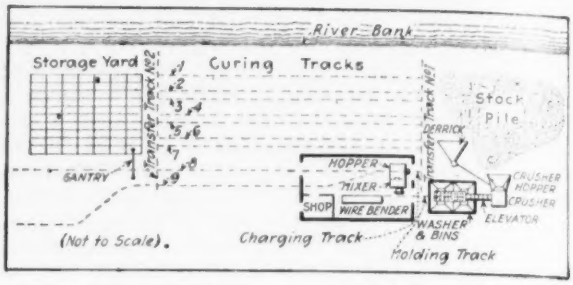


FIG. 3. LAYOUT PROVIDES FOR CLOSE SEQUENCE OF MOLDING OPERATIONS

screens, and sand and screened gravel are discharged into separate bins. Bottom gates drop the sand and pebbles into a partitioned car holding the exact amount and proportions for a batch. The car is pushed directly to the mixer and is side-dumped into the elevating charging skip. The derrick and the crushing and screening plant were assembled from equipment on hand. The mixer was also in stock.

Gang Mold on Flat-Car—From the mixer the concrete is discharged into a shallow elevated hopper with a side spout. A flat-car carrying a gang mold for 16 blocks passes under the hopper from the left, the molds are filled and the car passes out of the door to the right onto the rails of a transfer car which shifts the mold car to the curing track being filled, as shown in the layout, Fig. 3, and the view, Fig. 4. Here the blocks are spaded on the edges to flush the mortar against the forms, and are troweled smooth on top.

When the blocks are hard enough to handle, the mold car is run onto a transfer car on track No. 2 and is taken to the storage-yard track, where the blocks are removed and stacked by hand or by block and fall from the small portable gantry. When unloaded the car is again fitted up with the molds and proceeds to the mixer to repeat its service. The charging, molding and curing tracks are 24-in. gage; the transfer tracks are broad-gage and the tracks on the transfer car are, of course, 24-in. gage.

Second-hand brick-yard cars were the basis of the mold cars. These were fitted with heavy wooden platforms about 9 ft. long and 4½ ft. wide, and the tops of the platforms were covered with rust-resisting sheet metal. One hundred cars were fitted up. Each provided space for 16 molds, as indicated by the diagram, Fig. 5. Side and end boards and partition pieces 5 in. high formed the molds.

The ends and sides were single pieces of heavy board dished on the inside and sheeted with metal. The cross partitions, A-A, Fig. 5, were also single pieces dished and sheeted on both sides; they were made of 1-in. boards. The longitudinal portions, B-B, each consisted of four pieces of ½-in. board dished and sheeted on both sides. At each end these pieces had two tenons, b-b, which fitted into holes, a-a, in the cross partitions. When set up on the car platform, the assemblage of mold pieces was fastened rigidly by the wedges, c and

d, between the end plank and the fixed blocks, e-e. The metal setting was all No. 16-gage. The rods used to form the holes for the wire rope are placed in position, f, Fig. 6.

The car platforms and mold partitions were fitted and fabricated during the last winter by the men kept permanently on the contractor's payroll, and in the small shop shown on the plan. Only the sheeting was cut, stamped and punched at an outside metal-working shop. The car bodies cost, second-hand, about $10 each. The building of the platform and molds, including materials, cost $55 per car, making the total cost $65 for each mold car.

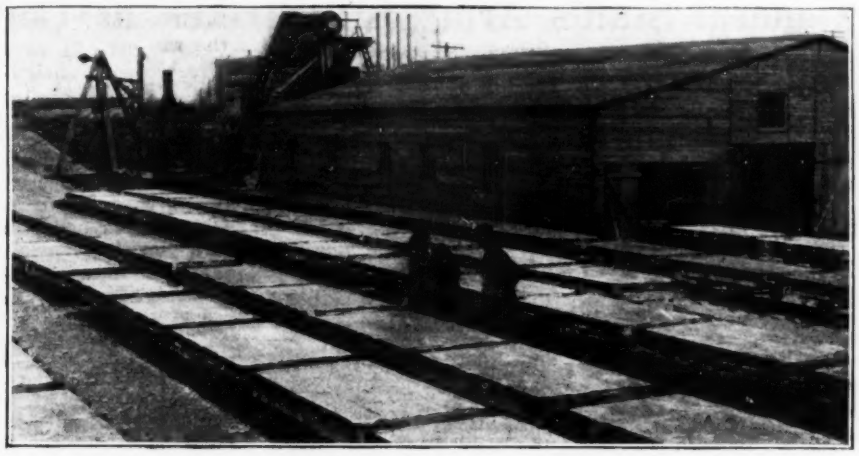


FIG. 4. MOLDING PLANT FABRICATES 1200 BLOCKS DAILY

Each block is reinforced by a one-piece wire frame bent as indicated by the block details, Fig. 2. To fabricate these frames from reeled wire, the apparatus shown in Fig. 6 was devised and built on the job. The reels of wire are placed on a spool set at an angle of

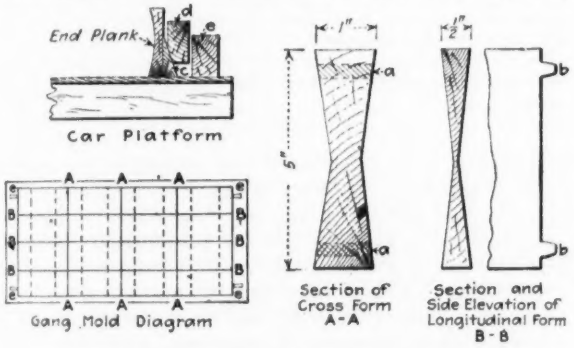


FIG. 5. DETAILS OF HOME-MADE BLOCK MOLDS

about 30° with the shop floor. This inclined position proved important; when set vertically or horizontally the spool did not unreel freely. From the spool the wire passes between the grooved wheels, A, and thence is threaded through a tube on the end of the hinged arm, B. It is then reeled single-lay on the device, C, which consists of a spur wheel from the face of which projects

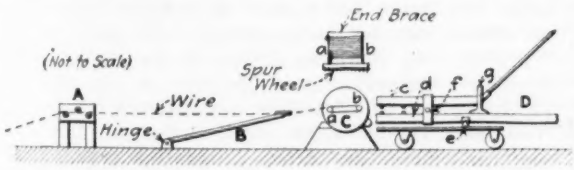


FIG. 6. IMPROVISED MACHINE FOR COILING AND FIXING REINFORCEMENT

the reel frame of two bars, a and b, braced apart at their outer ends.

As reeled on a-b the wire will uncoil partially when released, unless it is given a permanent set to keep it flat. The device, D, performs this setting operation. Two jaws, c and d, made of heavy timber are mounted on a car frame. These jaws are wide enough to embrace the full width of the flat reel on a-b. The lower jaw is hinged to the car platform at e, and the two jaws are hinged together at f. The car is pushed forward until the jaws grasp the reel of wire. The jaws are then closed with great force by means of the ratchet jack g, and the wire is set permanently into a flat reel. It is then cut at the proper points into the fractions of a reel necessary to form each a reinforcing frame for one block. These are bent to shape by hand.

When a car has been unloaded, its metal sheeting is cleaned and oiled and the forms are set up. Generally, the outside forms and the bars, f-f, for molding the holes have been removed as soon as the blocks are hard and while the mold car is on the curing tracks. By giving the bars a turn or two just as the block is taking its set they are easily pulled. The partition forms are removed when the blocks are unloaded for storage. All forms are cleaned and oiled for each set-up. The forms are set up complete with core bars in place and the reinforcing frame in position. The operation is rapid—when 1200 blocks a day are being molded 75 mold cars are prepared, poured and unloaded.

The plant was planned and constructed by the contractors, Price Bros., of Dayton, Ohio, with H. S. Price in direct charge.

Cost of Training the Students' Army Training Corps

Reporting the cost of the Students' Army Training Corps to the Committee on Education and Special Training, the business director, E. K. Hall, gives a gross cost, under original contracts and cancellation agreements, of $24,851,600. There were 686 contracts, or an average gross cost of $36,200 per contract. The total number of men for whose training the Government contracted was 228,990; but only 171,835 were actually inducted and in training on Nov. 15, 1918. Assuming the latter as in training from Oct. 1 to Dec. 21, 1918, an average of 82 days, these results are shown: Gross average cost per man trained, $144.50; gross average cost per trained man per day, $1.76. The cost of housing per man per day was $0.536; of subsistence per man per day, $0.724, and of instruction per man per day, $0.502.

The average cost for instruction under the vocational contracts was about 10% higher than the average for academic instruction.

General Staff's Army Bill Strikes at Corps of Engineers

Would Weaken Staff Departments' Control Over Their Own Operations—Line Favored in Naming of General Officers—General Staff To Be Absolute

There is now pending in Congress legislation governing the future military policy of this country. The administration bill, prepared by the Army's General Staff, grants to the latter body authority which, it is felt, will work to the disadvantage of such technical services as the Corps of Engineers. An engineer thoroughly familiar with the military establishment has submitted to this journal the following opinions on the subject.—EDITOR.

THE Secretary of War, under date of Aug. 3, 1919, transmitted to Senator Wadsworth for submission to Congress the draft of a bill drawn up by the General Staff of the Army, outlining a future military policy for the United States. The military student needs but a glance to realize that it is based on the Prussian system, though in some respects the bill outdistances the Prussian system in absolute General Staff control. When the civil world is turning to the technical man as the one preëminently fitted to solve the thousand and one pressing problems of a complex civilization growing ever more complex, this plan of the General Staff is calculated to put into a third-class position all technical organizations—if, indeed, it does not utterly destroy them—in the Army.

PROPOSED COMPOSITION OF ARMY

The first paragraph of the bill contains the following provisions:

That the United States Army shall consist of general officers of the line, a General Staff Corps, an Adjutant General's Department, a Judge Advocate General's Department, a Quartermaster Corps, a Medical Department (which shall consist of a Medical Corps, a Dental Corps, a Veterinary Corps and an Army Nurse Corps), a Corps of Engineers, an Ordnance Department, a Signal Corps, an Air Service, a Tank Corps, chaplains, band leaders, a Bureau of Insular Affairs, a Militia Bureau, detached officers, the professors and cadets of the United States Military Academy, detachments for schools and disciplinary barracks, the infantry, the cavalry, the field artillery, the coast artillery corps, an Officers' Reserve Corps, unassigned recruits, and the officers and enlisted men of the retired list.

This first paragraph tells what the Army is to be composed of, while the following sections or parts thereof show how the General Staff proposes to throttle all ideas except its own:

Section 2. . . . There shall be in the *line* of the Army six lieutenant generals, 32 major generals, and 88 brigadier generals. The general officers of the line who are authorized in this act for the various branches of the service shall be included in these numbers, and *the assignment of general officers to any branch, corps or department shall not create vacancies among general officers of the line.*

The Chief of Coast Artillery, officers on the active list who have held the rank of general officer by detail as chief of staff corps or bureaus, and the general officers of the staff, except those of the Medical Department, shall, on the passage of this act, be recommissioned as general officers of the line in the grades and with the dates of rank now held by them or heretofore held by them as head of a staff corps or bureau. In time of peace general officers of the line shall be appointed from the next lower grade of the line of the Army.

Section 3, Paragraphs 4, 5 and 7. The Chief of Staff, under the direction of the President or of the Secretary of War, shall have supervision of all agencies and functions of the military establishment, and shall perform such other military duties not otherwise assigned by law as may be assigned to him by the President.

The Chief of Staff shall be the immediate adviser of the Secretary of War on all matters relating to the military establishment, and shall be charged by the Secretary of War with the planning, development and execution of the Army program.

The duties of the General Staff Corps, under the direction of the Chief of Staff, shall be to prepare plans for the national defense and for the mobilization of the military forces in time of war; to investigate and report upon all questions affecting the efficiency of the Army and its state of military preparation for military operations; to render professional aid and assistance to the Secretary of War and to general officers and other superior commanders, *and to act as their agents in informing and coördinating the action of all the corps, bureaus and agencies* which are subject under the terms of this act to the supervision of the Chief of Staff; and to perform such other military duties not otherwise assigned by law as may from time to time be prescribed by the President.

Section 32. *The President may detail any officer to any military duty he may consider necessary and appropriate,* and for such period as he may think proper, subject only to the limitations contained in this act. The detail of officers to college duty and the employment of retired officers on active duty shall be as now provided by law, *but all other restrictions now proposed by law upon the assignment of officers for the performance of duties authorized by law are hereby repealed except as otherwise specifically provided in this act.*

"LINE" OFFICERS FAVORED

Running through all these paragraphs is the phrase "line of the Army." What is the "line of the Army"? As it is not defined in the bill, one must go back to precedent or to existing law for a definition. Heretofore the line has meant the infantry, the cavalry and the artillery. Every other department was a staff department. Indeed, in order that an engineer colonel in command of a regiment of engineers, while operating with a platoon of infantry commanded by a second lieutenant, should not be under the command of the second lieutenant, it was necessary a few years ago to pass a law that thereafter an engineer officer on duty with troops was a line officer. There is nothing in this bill that shows that an engineer officer on duty with troops is in the future to be a line officer. On the contrary, the second paragraph of Section 2 indicates clearly that the Corps of Engineers is a staff corps or bureau and hence not a part of the line. And only line officers may be made generals! Is this intended to prevent any engineer officer in the future from becoming a general officer? Is this in line with the "Psychology of War," a Fort Leavenworth textbook of a few years ago, in which occurred the statement that "engineer officers are fitted neither by training nor experience to command troops"? By the shades of Lee, Kitchener, Meade, McPherson, Johnston, what a thought!

Let us see just what the policies outlined in the above-quoted parts of the bill indicate. Under Section 2, in the second paragraph, it is noted that every chief of a *staff corps* on the active list of the Army is to be made a line officer upon the passage of the bill. The last sentence of that paragraph states that "general

officers of the line shall be appointed from the next lower grade of the line of the Army." Thus we see that after the present staff officers are put into the line no staff officer may ever be commissioned a general. The only exception to this is in the Medical Corps, whose chief is not to be made a line officer.

Furthermore, all staff departments, or rather "corps and bureaus," as they are called in this bill, except Engineers and Medical, are to have their commissioned personnel made up of details from the line. Thus, the man who aspires to make aviation his lifework, who aspires to serve in the Signal Corps, in the Judge Advocate General's Department, in the Finance Department, in the Motor Transport Corps, or in any of the other departments except the Medical and Engineers, must first pass an examination and become an infantryman, a cavalryman or an artilleryman. Under this rule he may never become anything else unless appointed a general officer. And, furthermore, he cannot, until he becomes a lieutenant colonel, ever spend more than four years out of any six in the staff department in which he would like to serve. From the infantry, the cavalry or the artillery, which he is forced to wed, he may never be divorced. What is the object?

The seventh paragraph of Section 3 states in part, "to render professional aid and assistance to the Secretary of War and to general officers and other superior commanders, *and to act as their agents in informing and coördinating the action of all the corps, bureaus and agencies which are subject under the terms of this act to the supervision* of the Chief of Staff." The eighth paragraph of that section states, "*the Chief of Staff shall be the immediate adviser of the Secretary of War on all matters relating to the military establishment,* and shall be charged by the Secretary of War with the planning, development, and execution of the Army program." Finally, Section 32 says, in part, "*the President may detail any officer to any military duty he may consider necessary and appropriate, and for such period as he may think proper, subject only to the limitations contained in this act.*"

General Staff To Be Absolute

Thus, the General Staff is to become absolute in every respect. It not only performs its proper duty as outlined in the first part of Paragraph 7, Section 3, " . . . to prepare plans for the national defense and for the mobilization of the military forces in time of war; to investigate and report upon all questions affecting the efficiency of the Army and its state of preparation for military operations," but it is to operate directly all staff functions, except the Medical Department and the Corps of Engineers, and by its authority to put staff officers in any place whatever to control in every detail, even those two departments. Combine all this *with promotion by selection provided for by Section 33 of this bill,* and czarism by heredity would have nothing on the General Staff of the United States Army.

This General Staff proposition is fundamentally wrong. What is needed is a strong General Staff, but it must be the planning, the controlling and the coördinating body of the Army, and nothing else. War plans, Army organization, coördination of the work of the various departments—there the duty of the General Staff ends. The instant it attempts to operate staff departments, or to lay down detailed rules of research or action in the development of technical departments, it ceases to be a planning and coördinating body and becomes an operating one. It ceases to be the "board of directors" and becomes the "operating department" of a great organization.

If the plan of the General Staff prevails, the man in a scientific department, with the two exceptions noted, far from being encouraged to put his thought and mind upon that department, is forced to stand or fall, when up for promotion, on his skill as an infantryman, a cavalryman or an artilleryman. Be he ever so wrapped up in the department he is serving, he will always be haunted by the specter of examinations in cavalry drills, in infantry tactics or in artillery firing, knowing that if he fails in those subjects he will not only lose his standing militarily but may be forced completely out of his chosen life's work.

Our staff departments must have their own officers commissioned in their own corps. When the war broke out the two departments that made *noteworthy successes without reorganization* were those two departments without any detailed officers in them, the Medical Corps and the Corps of Engineers. On the other hand, the most signal failures, requiring the most drastic reorganizations, occurred in the staff departments *made up largely of officers detailed from the line.* Such were the Ordnance Department, the Quartermaster Department and the aviation branch of the Signal Corps.

To Broaden Training

Not only must we commission officers in the various staff corps in order to keep them as specialists in those corps, but *we must go one step beyond what has ever before been done.* We must broaden the view of the technical man, and, let us not forget, we must broaden the view of the line officer at the same time.

Thus, instead of detailing line officers to do technical work in staff departments, let us, one year out of each five, detail the technical man to duty, say, four months with the infantry, 10 days with the cavalry, four months with the artillery, and the rest of the time with the other services with which he may come in contact. The technical officer will come back at the end of the year infinitely better fitted for work in the front line or in the laboratory in war.

In the same way, detail the line officer for duty with the staff departments. Let the line officer know that the duties of engineers are to build roads, lay out trenches, do demolition work, and do the scores of other highly technical jobs that devolve upon engineers in war. Your line man will come back with the proper vision and with better ideas on how to teach coöperation among all departments, by which means only can efficiency in war or peace be obtained.

Such a plan as this will develop generals, whether from the line or the staff, who will see that skilled engineers are not held as infantry reserves; who will see that highly valuable gas troops when bitterly needed in the front line are not put to work on roads; who, in short, in the future will see that trained and skilled staff soldiers are not set to doing work for which they are poorly fitted and for which other men can be trained in a quarter of the time.

Since every officer aspires or should aspire to become a general, let us see what are the qualities needed in a general. Decision? Yes. Executive ability? Yes. Boldness at times? Yes. Caution at other times? Yes—

but these qualities will not enable him to win battles unless he combines with those qualities a knowledge of the relative capabilities of a score or more of services in addition to the infantry and the artillery.

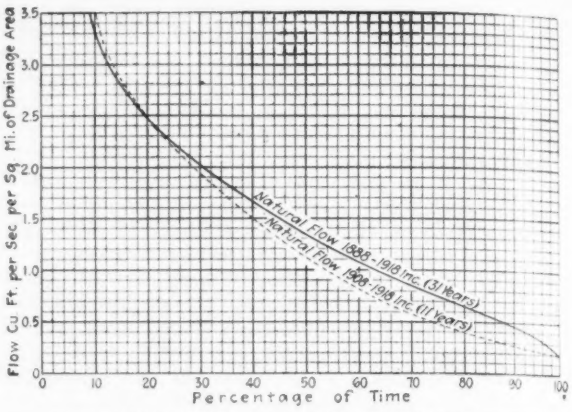
Then let the technical man of America rise and demand that this assault upon his profession be crushed; that the technical man be accorded in the Army, as he is accorded in civil life, an equal opportunity with all others to rise to any position to which his work and ability will carry him. Let the best officers become the generals of the future, be they from the infantry, the cavalry, the engineers or any other branch of the service, not excepting even the Medical Corps.

With this accomplished, your great general of the future as of the past may come from the line or he may come from the staff. He may be a Napoleon from the artillery, a Grant from the infantry, or a Lee or Kitchener from the engineers.

Long-Term Variations in the Flow of the Hudson River

By Edward H. Sargent
Senior Assistant Engineer, New York State Conservation Commission, Albany, N. Y.

PRIOR to 1907 very few stream gagings had been established in New York State. In that year the Water Supply Commission, now the State Conservation Commission, installed many stations. It was fortunate that this was no longer delayed, for 1908 and 1909 were extremely dry years. (See article, "Long-Term Variations in Stream Flow, Croton and Hudson Rivers," by the writer, *Engineering News*, Dec. 3, 1914.) Records have been kept at these stations up to date and it is thought that hydraulic engineers might be interested in learning how the flow for the period 1908 to date compares with the long-term flow, as shown by duration curves with the Hudson River at Mechanicville (drainage area, 4517 square miles), where records have been kept since 1888. Duration curves for the flow during these two periods have been computed and are shown on the accompanying diagram. The flow of the Hudson River at Mechanicville, since 1899, has been somewhat modified by the storage in the Indian Lake Reservoir, but this storage has been eliminated and the curves represent the computed natural flow of the river, except in so far as the flow is affected by the diversion to the Champlain Canal which affects both curves equally. It is apparent from an inspection of these curves, and it is further confirmed by a detailed study of the records, that there have not been sufficient wet years since 1908 to offset the dry years, and consequently the low-water portion of the duration curve for the last decade falls below the curve for the long term. It is evident that estimates of power based on the records from 1908 to date are conservative and that in the long run more power would be available.

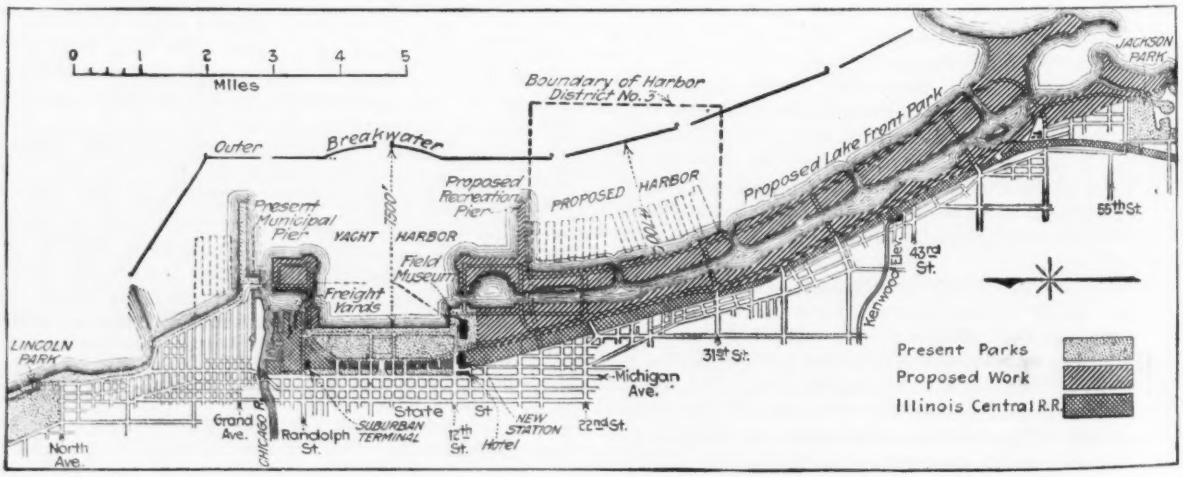


DURATION CURVES OF FLOW OF HUDSON RIVER

The records obtained at the various gaging stations in New York State can be found in the annual reports of the Conservation Commission and in those of the State Engineer and Surveyor, and also in the Water Supply Papers of the United States Geological Survey.

Correction—Chicago Lake-Front Improvement

The transposition of the explanations of the symbols carried in the legend on the map of the Chicago lake-front improvement, in *Engineering News-Record* of July 31, 1919, p. 216, makes it desirable to publish that the dotted area represents existing parks; the heavy single hatching shows the proposed lake-front development, and the double hatching indicates the property of the Illinois Central R. R. The map is printed again, in the illustration reproduced below, with the correct legend.

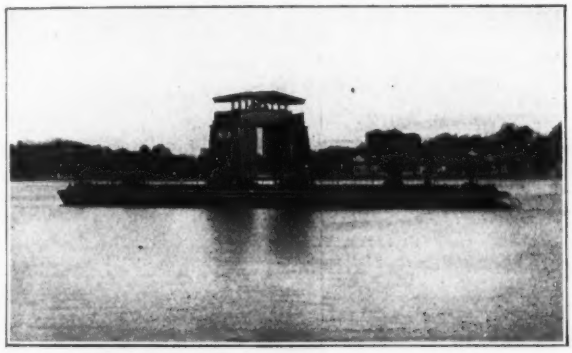


Concrete Barge Survives Launching at Singapore

Though Big Hole Was Punched in This Far Eastern Pioneer Concrete Vessel, It Was Soon Repaired for Service

CONCRETE ship construction has been started in the Far East. From China there have come a number of accounts of barges and even of oceangoing steamers, and now Singapore reports the construction of a large barge which through its survival of a launching accident testifies to the value of this new type of marine construction. This vessel is a reinforced-concrete car float built for the Federated Malay States Railways in 1917 by Brossard, Mopin & Co., of Singapore, and launched by the Singapore Harbor Board.

For some years the Straits of Johore, between Singapore Island and the State of Johore, have been connected by both passenger ferry boats and car-float ferries. Recently increased traffic made it necessary to add to the car floats, but as steel was practically unobtainable in the Far East during the war, reinforced concrete was adopted in preference to the remaining material, wood. P. H. Barriere, the Singapore representative of Brossard, Mopin & Co., was called in to design the reinforced-concrete car float, maintaining the general di-

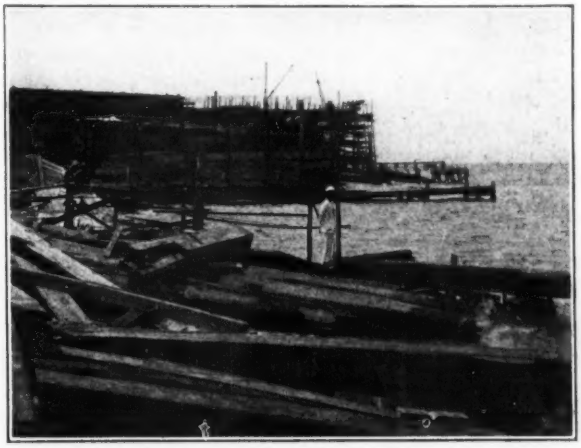


127-FT. CONCRETE CAR FLOAT OPERATING AT SINGAPORE ACROSS THE STRAITS OF JOHORE

mensions of the existing steel boats. These dimensions are: Length, 127 ft.; molded depth, 7 ft. 6 in., and beam, 27 ft. It is designed to carry safely all necessary deck fittings and machinery and six freight cars on rails placed along the longitudinal axis of the boat. The total weight of machinery and cars is about 150 tons. Longitudinally the hull is divided into three parts by means of two bulkheads under the rail and 3 ft. 3 in. apart. Further transverse bulkheads provide water-tight compartments. The hull is 3 in. thick, reinforced with ½-in. bars spaced 4 in. in both directions. Only a part of the deck is of concrete; that is, at both ends, where heavy machinery is fixed. Amidships the deck is of 2-in. boards supported by transverse ribs.

Concrete was mixed in the proportion of 1½ : 2 : 4, with an aggregate of selected granite chips ⅛ to ½-in. size, and sea sand. The hull was rendered in a 1 : 2 cement-mortar. This adoption of this plaster was decided upon in order to combat the possible destructive effect of sea water, which is pronounced in the tropical seas of this vicinity.

The boat was built on transverse ways and supported on cradles and launching ways for side launching. At the moment the launching triggers were struck, however, one of the sliding ways at one end of the boat gave way. This end of the vessel slewed around, and under the unexpected strain the guides on the side of the launching ways gave way and a general collapse of the launching platform took place. One of the longi-



SHOWING PERMANENT LAUNCHING WAYS SHEARED CLEAN THROUGH

tudinal supports was stopped in its course, resulting in a drop of the boat of about 20 in., and the collapse of a cradle on the other side was responsible for a drop of about 6 ft. The shock of this last break was sufficient to break a 14 x 14-in. launching timber, where it was hit by the barge.

In spite of the accident, however, the boat righted itself and completed its course down the permanent ways to a well balanced flotation. For awhile it was thought that no damage was done, but a hasty inspection showed that several compartments were full of water. The boat was immediately beached and several holes similar to the one shown in the view were revealed. It was then towed to dry dock for repair.

There were altogether six damaged places, but in every case the damage was only local, extending a few

ONE OF THE HOLES PUNCHED IN CAR FLOAT

feet from the point of contact at the fall. The main structure was quite sound, presenting no cracks or other sign of deformation. In the dry dock the breaks were edged clean and concrete patches applied. After some tests and minor further patching, the boat was put in service and has been in successful service for a number of months.

Shipbuilding Equipment and Methods at Fore River
II—Shop Routing and Group Labor Systems

Hull Production Coördinated by Keeping Shop Ahead of Berths—Card System for Routing Material—Department of Material Stowage—Specialist Labor Groups—Piecework and Premium Payment

SHIPBUILDING at Fore River under the war-time pressure of the past two years, with greatly enlarged and modernized plant, and with a working force increased as fast as possible to about double the normal complement, led to some interesting changes in operating methods. Two developments of particular importance are a shop routing system, which schedules and keeps track of hull material from mold-loft to berth, and a specialist group labor system which has been applied to many of the outside departments, chiefly the fitting-out and trial departments. Notes on these two items of new system are given in the present article, to supplement a description of the hull-construction plant printed in *Engineering News-Record* of July 3, 1919, p. 19. It is worth emphasizing at this point, however, that the success of forced-draft shipbuilding at Fore River and the possibility of a quadrupling of the working force in not much more than six months by dilution processes alone depended very largely on the excellent quality of the old-time stock of shipbuilders in the yard, as well as on a remarkable spirit of drive and devotion which the entire organization exhibited. A few paragraphs dealing with this phase of the matter are given after the description of the operating methods noted.

Routing and Tracing Fabricated Material

When rapid production under the pressure of the war program started, fabricated material accumulated in such quantities that it made what seemed hopelessly unsystematic piles in the yard. With several hundred destroyer frames massed in a single pile, finding the right piece when wanted threatened to become impossible. It was necessary to develop a system for keeping track of every piece of finished material, and for detecting and expediting missing pieces.

A department of material stowage was therefore organized. This department, now comprising about 170 men, receives finished material at the weighing scales at the outgoing end of the fabricating shop, transports it and places it in storage, and remains in custody of it until delivery to the cranemen at the berths. It also keeps track of the requirements of the berths, and through this means it learns which pieces are missing, and traces out whether these have been made and misrouted or are as yet uncompleted.

System in fabrication, to produce material in the sequence required by the ships, is, however, equally important with system in stowing and locating finished material. To coördinate the shop production with the berth requirements, an effective shop routing system was worked out. Beginning in the mold-loft, it takes the material through the shop to the material stowage, and thus ties together the three elements of the hull department—the shop, stowage, and berth.

System of Routing Material Through Fabrication

An order-card system, originating in the mold-loft, is the key element of the routing system. One of its results is that several checks are obtained on missing parts, and means are provided for tracing up pieces which have been overlooked or misrouted, from the building berth back to the mold-loft. Another result, perhaps even more important, is that fabrication is arranged in such order as to produce sequence rather than tonnage. The inside and outside hull departments dovetail, and yet work independently.

Order Cards Start in Mold-loft—Every drawing is analyzed in the mold-loft as soon as received there, and the parts called for by it are divided into "fabricating groups." Thus, each bulkhead, each floor, the entire shell, each deckhouse, and the like, forms a group. For every group a bill of material (Fig. 1) is made out on a card, Card A, which routes the group through the mold-loft. The analyzing and billing are carried on by the engineering clerk of the routing department, who has an office in the mold-loft. He is assisted by the head loftsman. Each individual piece of material receives a mark, and the size of stock is noted; the latter is possible because of a complete card index of the stock of raw material on hand in the plate yard, made up daily from the reports of the foreman of raw storage and kept in a card file in the loft office.

These card mold-loft orders are arranged in the sequence required to allow time for making the molds and for fabricating, as determined by experience. They are then handed out to the individual loftsman for mak-

BETHLEHEM SHIPBUILDING CORPORATION, LTD.
FORE RIVER PLANT
T. DEPARTMENT. MOLD LOFT RECORD
SHAPES AUG 8 1918

2 Cards. Card No. 2 — Job Name FRAME 96 — Card No. — Hull No. 297-8

Item Ship Mark	No. of Pieces	Amount	Mill Mark	Dimensions	Material or Stock	Mold Loft or Layed	Checked: Layer-out	Checked: Layer-Driller	Remarks
297-2MC-96	4	14'-6"	ML-1	6 x 6 x .56	L	M.L	✓	✓	Patg 8-13-18
" 1-F-96	4	150'-0"	F-96	12x3.565x3.565 [	44	"	✓	✓	
" 2RF-96	4	84'-8"	RF-96A	3½ x 6 x .75	L	"	✓	✓	
" 1-BC	4	2'-4"	EB-6	3½ x 6 x .44	L		✓	✓	Patg 8-17-18

BETHLEHEM SHIPBUILDING CORPORATION, LTD.
FORE RIVER PLANT
T. DEPARTMENT. MOLD LOFT RECORD
PLATES AUG 8 1918

2 Cards. Card No. — Job Name FRAME 96 — Card No. — Hull No. 297-8

Item Ship Mark	No. of Pieces	Amount	Mill Mark	Dimensions	Material or Stock	Mold Loft or Layed	Checked: Layer-out	Checked: Layer-Driller	Remarks
297-4FB-96	4		FC-101	PART		M.L	✓	✓	Bodell 9-9-18
" 2R-1	4		UD-20	42 x 42 x .44		"	✓	✓	Bodell 8-12-18
" 5R	4		SG-1	30 x 30 x .40		"	✓	✓	

FIG. 1. MOLD-LOFT SCHEDULE CARD, LISTED FROM DRAWING CHECKED BY LOFTSMAN (CARD A)

ing molds of those items marked "ML" on the card, the lifted items being marked "L." As he makes the molds he checks off the successive items of the card and corrects any errors or omissions in the list; for example, he adds a missing dust collar on a floor frame. The molds themselves are checked for accuracy before they pass out of the loft, and here another verification of the card as well as of the mold is obtained.

When the loft card has finished with its final check, a copy is typed on a blank sheet with duplicator ribbon, and three copies of this sheet are made on separate cards (B, C and D) for the layer-out, the weighing office, and the department of material stowage. These are like the loft card except for the check columns. They are sent to the respective departments as soon as made out, and go on file there waiting for the material for which they call.

Work goes through the fabricating shop in a sequence determined by the layer-out in conformity with general orders issued from the superintendent's office, scheduling the major items of the required work. The foreman layer-out takes a B card from the "available work" box and hands it to one of his men as an order to lay out the group of material represented by the card. In case the card goes to several men, their respective names are properly entered opposite the items assigned to them. In this form the card goes to the material clerk, who requisitions the stock called for on the card. His requisition slips note (from the index of raw storage) the bay or section of the yard containing the required material, and also the name of the man to whom it is to be delivered. One copy of the requisition goes to the plate-yard foreman and one to the layer-out, the latter checking off the material as he receives it. When the piece is laid out he dates his copy of the slip, and from these dated slips a counter who makes the rounds once a day enters on the original group card the date of laying out. In this way the card automatically clears itself when all material on it has been laid out, or it comes up as a reminder if some of the parts remain uncompleted for an unduly long time; furthermore, the man who laid out the piece can always be traced, and errors or other unusual conditions followed up.

From the layout the material passes down through the shop without any accompanying order. At the scales it meets card C, which is in the hands of the weigh clerk. Here the weight is entered, and the piece is routed to the proper berth from the information given on the card; when completed the card is filed as a permanent record.

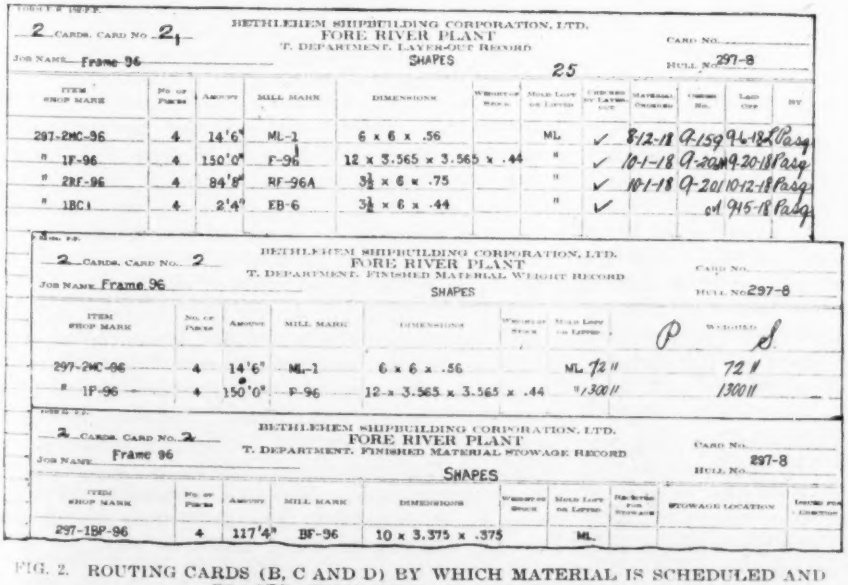
At the building berth the material meets the last card, D. A checker of the department of material stowage, at the berth, enters in a loose-leaf book the date of receipt and the location of the storage section in which he places the piece of material. A night clerk of the department receives all the checker's books and enters from them on the D card the date of receipt of the material opposite its item line. The location is not entered here, the checker at the berth being relied upon to locate all pieces from personal knowledge. However, the card shows when a given order is completed, and thus calls attention automatically to any forgotten or uncompleted items.

It is the duty of this stowage department to detect any omissions or delays in fabrication which would hold up the erection of the ship. Furthermore, in case material is found to be missing when called for by the rigger, the stowage clerk must trace it up through the series of records back to the layer-out, and hurry the missing part through. By this system the department of material stowage is enabled to provide for prompt supply of fabricated material and to hold the shop up to schedule. As the checkers keep posted in advance as to the needs of the various ships, it is possible to foresee shortages in delivery from the shop and take steps to change the fabrication schedule accordingly.

A few items are not handled by the group-card system. Tapered liners, for example, are in charge of a boss linerman, whose business it is to keep liners fitted and fabricated in advance of the setting of the plates to which they belong. Lifted work is made by card, but is handled on call from the berth. Orders, some 300 per day, pass forward from the office of the department of material stowage to the boss layer-out as soon as the ship has progressed to a point where the required molds can be lifted. From this moment on the procedure for the routing and entering on the card is the same as for mold-loft material.

Development of the routing system described began with a mold-loft schedule card devised by the head loftsman, and modified and enlarged to serve for the needs of the other departments through to the berths. The assistant hull superintendent was closely concerned with the working out of the system, under the general superintendent.

To bring the yard up to its full capacity (or, rather, overload capacity) in a few months—from about



2 CARDS. CARD NO. 2 — BETHLEHEM SHIPBUILDING CORPORATION, LTD. FORE RIVER PLANT — T. DEPARTMENT. LAYER-OUT RECORD — SHAPES — 25 — JOB NAME Frame 96 — CARD NO. — HULL NO. 297-8

ITEM SHOP MARK	No. OF PIECES	AMOUNT	MILL MARK	DIMENSIONS	WEIGHT EACH	MOLD LOFT OR LOFTED	CHECKED BY LAYER-OUT	MATERIAL ORDERED	ORDER NO.	LAID OFF	BY
297-2MC-96	4	14'6"	ML-1	6 x 6 x .56		ML	✓	8-12-18	9-159	9-18	Pasq
" 1F-96	4	150'0"	F-96	12 x 3.565 x 3.565 x .44		"	✓	10-1-18	9-201	9-20-18	Pasq
" 2RF-96	4	84'8"	RF-96A	3½ x 6 x .75		"	✓	10-1-18	9-201	10-12-18	Pasq
" 1BC1	4	2'4"	EB-6	3½ x 6 x .44		"	✓			9-15-18	Pasq

2 CARDS. CARD NO. 2 — BETHLEHEM SHIPBUILDING CORPORATION, LTD. FORE RIVER PLANT — T. DEPARTMENT. FINISHED MATERIAL WEIGHT RECORD — SHAPES — JOB NAME Frame 96 — CARD NO. — HULL NO. 297-8

ITEM SHOP MARK	No. OF PIECES	AMOUNT	MILL MARK	DIMENSIONS	WEIGHT EACH	MOLD LOFT OR LOFTED	P	S
297-2MC-96	4	14'6"	ML-1	6 x 6 x .56		ML	72 #	72 #
" 1F-96	4	150'0"	F-96	12 x 3.565 x 3.565 x .44		"	1300 #	1300 #

2 CARDS. CARD NO. 2 — BETHLEHEM SHIPBUILDING CORPORATION, LTD. FORE RIVER PLANT — T. DEPARTMENT. FINISHED MATERIAL STOWAGE RECORD — SHAPES — JOB NAME Frame 96 — CARD NO. — HULL NO. 297-8

ITEM SHOP MARK	No. OF PIECES	AMOUNT	MILL MARK	DIMENSIONS	WEIGHT OF EACH	MOLD LOFT OR LOFTED	RELEASED FOR STOWAGE	STOWAGE LOCATION	LOCATION FOR ERECTION
297-1BP-96	4	117'4"	BF-96	10 x 3.375 x .375		ML			

FIG. 2. ROUTING CARDS (B, C AND D) BY WHICH MATERIAL IS SCHEDULED AND TRACED FROM STORAGE PILE TO SHIP

4000 workers at the close of 1916 to over 20,000 a year later—it was necessary to take men of any grade available. Shipyards everywhere were bidding for men at this same time, and most of the men obtainable, therefore, were not only without shipyard exeperience but without any kind of mechanical training. Apprenticeship and intensive training were equally out of the question under the hurry conditions. The only thing that could be done was to put the men to work, under department and squad foremen who needed them and would develop them as rapidly as possible.

Success of Dilution System

This dilution process was successful. The credit, in large part, is given by those familiar with the plant to the men composing the core of the force. Many of these had been with Fore River for many years. In normal times Fore River draws its supply of labor from a population gifted with the native New England aptitude for mechanical work. Long service had produced a strong yard spirit, moreover. The foremen and gang leaders, and even the individual workmen, adapted themselves to taking up and using and training the newcomers energetically and devotedly. In many departments all the original workmen became gang leaders and subforemen. Throughout the organization a remarkable degree of effort was applied to the many-sided problem of high-pressure production with a green force, and it was this that brought success. The leaders in particular gave no thought to hours.

Due to the length of time required for developing skill in the new men, and the necessity, at the same time, of working up to schedule, the plan of developing efficiency by narrow specialization was tried. As a result, the yard organization has been developed so that there is a large number of individual specialist groups, chiefly in the outside work, which are shifted from ship to ship and work under a general supervisory force.

The plan of group organization is illustrated in the case of stern tube boring. Here men of four or five crafts are required, staging builders, electricians, riggers, machinists and the like. Such a gang is organized under the chief machinist, he being the man in charge of the principal operations. Prior to organizing this fixed group, it took 54 hours to bore the stern tube. With the group trained in working together, the time was progressively cut down to eight hours.

This is an extreme case of improvement in efficiency, perhaps, but gains have been recorded in all cases, largely because the men work together and acquire the routine of carrying out the successive steps of the work in proper order, in the most efficient way, and without loss of time. The same principle of organizing the group is followed in each case that was indicated above; the controlling operation determines who is placed in charge. In the gang which fits the periscope on submarines, for instance, the chief hull man is made foreman of the group.

First application of the specialist-group idea was made in the trial trip crew. The superintendent of machinery organized such a crew in the summer of 1918, when it became evident that, especially when destroyers were being produced at a rapid rate, prompt acceptance depended on handling the trial trip with a crew as well trained to the work as a regular sea-service crew. A "hand-picked" crew was made up, composed of men especially competent in the several branches of the work. In a short while this crew was so well trained to working together that it could get a better performance out of a new boat than the regular operating crew would be likely to secure in the first weeks of operation. A brief description of the trial-crew system was given in the *Emergency Fleet News* of Nov. 7, 1918, and it was there stated that "the practice of having the same men take out all ships has distinct value, inasmuch as it keeps the crew in constant touch with the problems that come up in trial trips and has resulted in the stopping of many faults on the instant; and here, as in everything else, the first step toward correction is discovering the trouble."

At present about a dozen of these specialist groups, some of them containing from 20 to 50 men, exist in the yard. The most important of them, besides the trial crew, are the various groups at the fitting docks. In the first section of the wet basin, where boilers are set, the work is handled by a hull group and an engineering group. In the second section, to which the boat is moved as soon as the heaviest installation work has been done and lighter crane service suffices, two engineering groups and one hull group are provided. One assistant to the superintendent is charged with the special duty of keeping track of all group operations and coördinating the various departments in their relations to them and providing against interferences.

Working at High Pressure

"One thing we are strong in," said an official of the yard, "is pinch-hitting. You can't develop that on money; you have to put the spirit into the men." This statement reflects the intense and willing concentration of effort in emergencies that was necessary for maintaining continuity of production under the extreme conditions imposed by the war demand. Men at Fore River say that the spirit needed for such concentration was there at all times, and could be depended upon in spite of the great dilution of the old-time labor stock and in spite of the unrest produced by the rapidly changing economic conditions.

An incident bearing on the working spirit is the following: During the builder's trial of a destroyer, the turbine rotor was damaged and the boat returned to its dock. This was at 3:30, on a Saturday afternoon, when the yard forces were scattered and there seemed no likelihood that anything could be done until Monday. Destroyers were never more urgently needed, and a delay of several days was a grave matter. The men in the yard knew this. Some of the installation machinists were still at hand when the boat came in, and they took hold of the job without waiting for orders.

By seven o'clock in the evening the rotor had been taken out of the turbine and was being hoisted out of the boat. In the meantime the superintendent had arranged for the necessary work in the shop, and before dark the rotor was under repair. The shop gang stayed at their work all night and Sunday morning, and by 11 o'clock on Sunday they were able to deliver the rotor to the destroyer dock. Here the installation force was ready for it, and at 6 in the evening their job was done. Monday morning at 8 the destroyer went out on its official trial trip, and was accepted.

Work at Fore River has been carried on by piece-

work and premium payment, practically to the exclusion of time payment. In the fabricating shop, straight piecework payment is most largely used; only occasionally is there an item of work suitable for setting time and paying premiums. Similarly, hull work is carried out so far as possible on a piecework basis. In the mechanical shops, on the other hand, premium payment is the rule, and an elaborate time-setting and rate-fixing department controls the work. A factor in the smooth working of this system has been the use of skilled craftsmen as time and rate setters.

Ownership of Plans and State Engineer's Right to Practice Defined

FROM time to time ethical questions come before the American Institute of Consulting Engineers for decision, and these are submitted to the committee on professional practice and ethics. The report of the committee is published in bulletin form. Two definite questions were recently submitted to the committee and the report has been made. They concern the rights of the engineer in regard to plans which he has prepared, and the right of engineers in public office to carry on private practice in lines and on projects which are likely to come for decision before the boards which they represent. These questions are known as cases 11 and 12; the questions and answers are given herewith:

Contractor's Right to Copyright Plans

Case 11—An engineer was retained by a client to advise him in reference to an engineering project and structure. The engineer submitted with his report complete drawings of the structure recommended by him. The client, with the permission of the engineer, submitted the plans to an engineering-contracting company, inviting a proposal to do the work. With such proposal the engineering-contracting company submitted a drawing identical with that of the engineer except that a few minor details and additions were included. Upon this drawing were stamped the words "Copyrighted by X-Y" (the title of the company).

Question: Was it a violation of professional ethics for X-Y to copyright the drawing under the conditions named?

Answer: The right of X-Y to copyright plans or documents originated and prepared by them cannot be questioned. This is also true of changes made by them in the designs and drawings prepared by others; provided it is made clear that the original plans are not their own; and that the changes or additions made by them, upon which copyright is claimed, are specifically described. In the case before us, it appears that this was not done.

X-Y had no title by authorship, ownership or assignment to the original drawings, and therefore no right to appropriate and copyright them. By copyrighting them the engineer himself is debarred from using them without their consent or compulsion. The copyright leads to the natural inference that the plans were designed and prepared wholly by them.

To copyright the drawings under these conditions, whether intentionally or inadvertently, was morally wrong, unjust and discourteous to the engineer, and therefore a flagrant violation of professional ethics.

Case 12—Engineer A is appointed to a state board which, by legislative enactment, is required to pass upon plans, specifications and designs for certain types of municipal improvements. This board also has jurisdiction over and is required to inspect and report upon the operation of certain types of municipal plants. This engineer, while sitting on the board and passing upon the plans and operations of the plants mentioned, practices in the state in which the board upon which he sits has jurisdiction, and prepares plans and specifications for plants which must be passed upon by the board, and also installs and operates plants, the inspection and operation of which it is the function of this board to regulate.

Question: Is it proper, or in accordance with professional ethics, for an engineer, while serving as a member of a public commission, to accept professional engagements that involve, or may involve, questions or matters that will come before the commission for official decision or action?

Answer: A fairly parallel question would be: Is it proper and in accordance with professional ethics for a judge to consult with, advise, and prepare, for a client, a suit at law that is to be tried before him as presiding judge?

The answer is as obvious in one case as in the other.

An engineer who accepts a public or quasi-public appointment under the conditions named in the statement is thereby debarred, not only by professional ethics, but by moral obligation and sound public policy, from accepting any engagement involving matters that may eventually come before him in his public capacity for consideration and decision.

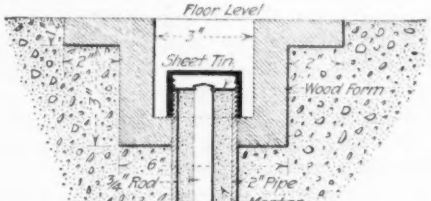
Evidence of intentional violation of this principle should be sufficient cause for the discipline or removal of the offender.

Depressed Permanent Bench Marks Set in Concrete Floors

By L. C. Scott
Sparrows Point, Md.

PERMANENT bench marks may be placed in old or new concrete floors by grouting iron rods in iron pipe with screw caps. In the case of old floors the holes must be cut, but in new floors the pipe may be set in the wet concrete by means of a circular form, shown in the illustration. When installed the device is a permanent and well protected bench.

To form the bench in old concrete a rough hole at least 1 in. larger than the wood form is dug. A ¾-in. rod slightly pointed at the upper end and notched with a hack saw about ½ in. down from the top is hung on the inside of a short piece of 2-in. iron pipe and set in



METHOD OF SETTING DEPRESSED BENCH MARKS

the middle of the hole. The rod is supported by a piece of sheet tin which fits into the notch and rests upon the top of the pipe within the screw cap. The pipe and rod are now grouted in by pouring around the outside of the pipe, which, being open at the bottom, fills up.

When setting benches in wet concrete the wood form is set flush with the floor level and thin concrete without coarse aggregate is worked around it. As it is worked, the mortar will rise through the bottom of the pipe around the iron pin. After the concrete has set, the wood form may be removed and also the cap and tin plate, and, if necessary, the pipe may be grouted.

In both cases, after the concrete has set, a 1-in. circular steel plate should be placed in the depression left by the wooden form. The screw cap forms a perfect protection for the bench, and the elevation should be stamped on its inner face, so as to be always available. This last precaution also insures the removal of the cap to obtain the elevation before holding the rod.

Extraordinary Repairs Made to a 1900-Ton Drawbridge

Turntable, Wheels and Drum Failing, the Number of Wheels Was Increased and New Upper Treads Placed—Drum Parts Restored by Heating and Jacking

By Thomas D. Fulton
Field Engineer, Bethlehem Steel Bridge Corporation, Bethlehem, Penn.

INCIPIENT failure of the turntable of the 1900-ton drawbridge by which the Lincoln Highway crosses the Passaic River east of Newark, N. J., required difficult repair and reinforcement work. Quite unusual methods had to be adopted, as it was vital that the bridge be kept in service while repairs were being made. Important war plants depended on the highway and river for their principal communication. The report of the Essex County engineer for 1918 shows that the drawspan was opened 9172 times during the year, an average of about 28 times per day when the river was free of ice as was the case during the past winter. Practically 5000 vehicles use the highway each day between 8 a.m. and 6 p.m. The total daily tonnage averages approximately 15,000 tons, exclusive of trolley cars.

The repair work included replacing the roller wheels and top treads, straightening the drum girder flange and stiffener angles by oxyacetylene heating, reinforcing the drum with special cast-steel stiffeners, installing new center pin and casting, providing properly for expansion in the fixed spans, and overhauling the driving machinery.

Origin of Bridge Troubles—During the work, conditions were found which help explain the origin of the troubles. As described in *Engineering News-Record* of Apr. 18, 1918, p. 775, the bridge was in such grave condition that the Public Utilities Commission demanded that immediate repairs be made to the turntable drum, to assure the safety of the street-car traffic. The wheels supporting the drum were breaking frequently, the upper tread was broken and bent out of shape traversely, and the drum girder flange and stiffeners were bending and buckling. The center casting, designed to hold the span in position, was loose and shifted around on the masonry as the span was turned.

The bridge was practically new, having been built in 1910. Soon after its erection the center casting broke and was replaced by a new solid casting with an 8½-in. pin, the design having been changed for erection purposes. Unfortunately, it was not possible, on account of the live-ring collar, to place anchor bolts of sufficient length to hold the new casting securely in place. The movement of the span off center at times, therefore, became so great that the driving pinions with gear teeth $2\frac{13}{16}$ in. deep were thrown out of mesh with the rack. This shifting of the span placed excessive stress on the live ring and the axles of the roller wheels, which were thus forced out of adjustment so that only a few wheels carried the load. Under this excessive loading many of them broke and, according to the bridge engineer of the Public Utilities Commission of New Jersey, the drum was strained so severely that its complete failure and collapse was considered possible.

Replacing the Rollers and Upper Tread—The number of roller wheels was increased from 52 to 65, adding one to each of the 13 sections. This necessitated the drilling of 52 holes in the inner and middle live-ring channels for the 2½-in. axles, locating them on exact radial lines; replacing the old outside channel of the live ring with 13 new and shorter sections; replacing the old horizontal plate separators between the wheels with vertical cast-steel separators; and adding new wheels and axles. This work was carried out by holding up bridge traffic ten or fifteen minutes at a time, when necessary.

The new top tread plates were erected by working four night shifts, one of 12 hours and three of six hours each, during which time the bridge, it was advertised, would be closed to all traffic. For this operation, five wheels were removed under one section and this outside live-ring channel section was replaced with separators. The old section of the top tread plate was removed and replaced with a new temporary section beveled from $1\frac{5}{8}$ in. at one end to 2 in. at the other, to allow for the ⅜-in. difference in thickness of the old worn plate and the new plates. The bridge was then revolved to bring a second section of old plate to the section of the live ring where the wheels were removed and, after wedging off the broken pieces of the old plate, the first new permanent top tread plate was erected. Sufficient holes were reamed out for special countersunk Mayari steel bolts to hold the new plates in position until all holes could be reamed out and 1½-in. rivets driven.

Another beveled plate was then placed to connect up the new plate with the next old plate, and the bridge was opened to traffic and allowed to operate slowly when necessary during the day. The second night, one beveled plate was removed and three more new plates were erected, care being taken in reaming the holes in the drum girder flange angles from ⅞ to $1\frac{3}{16}$ in. to keep the tread plates in a true circle and the joints tight. The last of the 16 plates was drawn into position with drift pins, making tight joints at both ends.

Straightening Drum Flange and Stiffeners—With special steel templets four $\frac{13}{16}$-in. holes were drilled in the web plate of the drum girder for each pair of the new cast-steel stiffeners, as shown in Fig. 1. Each

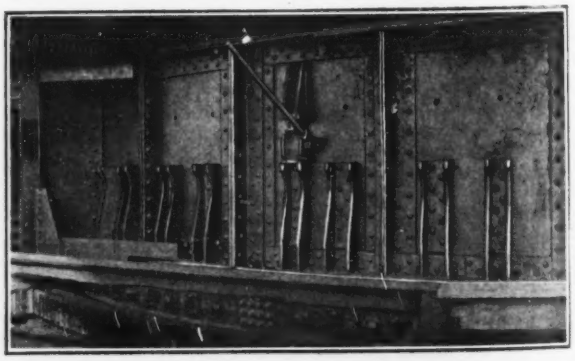


FIG. 1. NEW CAST-STEEL STIFFENERS AND SPECIAL JACKING BRACKET

stiffener had eight 1-in. holes. Also, one hole was drilled in the drum above each stiffener for holding the special jacking bracket. The stiffeners were then placed and held in position with ⅞-in. bolts while being forced down to a bearing on the flange angles and tread plate with 25-ton jacks. At the same time, heat was applied to the back of the flange angle with two oxyacetylene blowpipes, and 12-lb. mauls and Mayari steel bolts were used in forcing the angles to a bearing on the tread plates, as shown in Fig. 2. The other four holes were then drilled in the web of the drum girder to full size, and 1-in. rivets were driven. The four bolts were removed, holes were reamed out, and rivets were driven

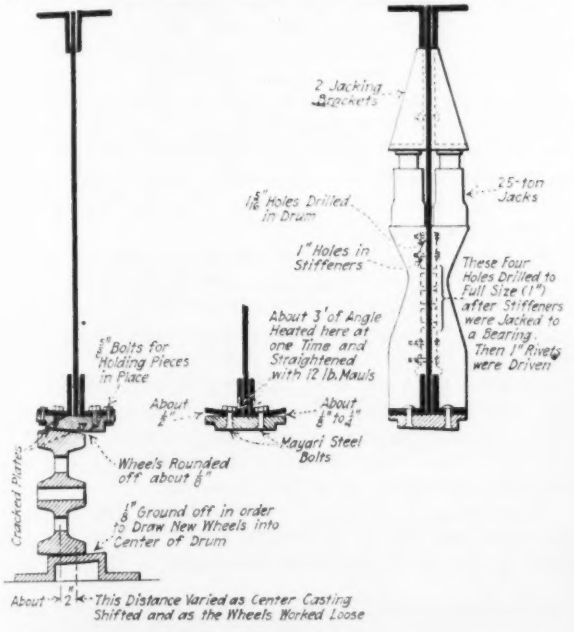

2 Jacking Brackets
25-ton Jacks
1⅛" Holes Drilled in Drum
1" Holes in Stiffeners
These Four Holes Drilled to Full Size (1") after Stiffeners were Jacked to a Bearing. Then 1" Rivets were Driven
About 3' of Angle Heated here at one Time and Straightened with 12 lb. Mauls
⅞" Bolts for Holding Pieces in Place
About ½"
About ⅜" to ½"
Mayari Steel Bolts
Wheels Rounded off about ⅛"
⅛" Ground off in order to Draw New Wheels into Center of Drum
Cracked Plates
About 2½"
This Distance Varied as Center Casting Shifted and as the Wheels Worked Loose

FIG. 2. DIAGRAMMATIC SKETCHES SHOW HOW DRUM GIRDER FLANGE WAS STRAIGHTENED

before the jacks were removed. All the holes for connecting the new tread plates to the flange angles were reamed out and 1⅛-in. countersunk rivets were driven.

The drum stiffener angles, the outstanding legs of which had been bent badly out of line, were heated and straightened. Vertical reinforcing plates were wedged in between the flange angles of the drum girder, riveted to the stiffener angles, as seen in Fig. 1. All loose rivets in the drum flange angles and splices were cut out and redriven.

New Center Pin and Casting—It was decided that the most feasible way to hold the span in position was to install a new center pin with a casting having a larger base so that it could be securely held with anchor bolts. By means of a steel templet placed around the old center casting, the center of the drawspan was determined. Thirteen 3½-in. holes were drilled in the granite masonry for the 3-in. anchor bolts, and eight 3½-in. holes were drilled for wedge bolts which could be inserted in pipes grouted in the holes and flush with the top of the masonry. The wedge bolts had square heads to be used in wedging the casting into position, as indicated by the sketch, Fig. 3.

After the thirteen live-ring struts were removed and the sixteen radial girders were disconnected, the casting, with collars in place, could be slid out. As the

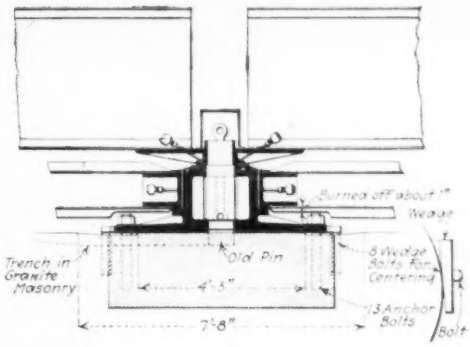


FIG. 3. NEW CENTER CASTING AND BOLTS FOR SECURING IN PLACE

center pin could not be pulled out of the old casting, two of the radial girders had to be cut to clear the top of the pin. The collar which connected the drum radial girders to the center casting had been badly worn. It was taken to a machine shop and bored out to fit the new pin, which was provided with a bronze bushing. The new iron center casting, Fig. 4, was made with a running fit for the live-ring collar. This collar had been protected from wear by a bronze bushing fitting over the old casting. However, this bushing had worked

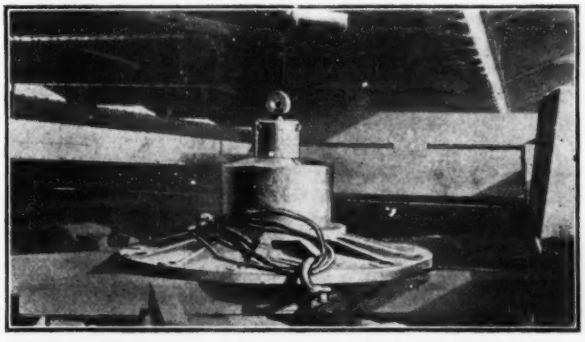


FIG. 4. NEW CENTER PIN AND CASTING BEFORE PLACING

loose and was being flanged out by rubbing on the radial girder collar above.

The eight wedge bolts held the new casting in position while the span was operated and the machined anchor bolts were being placed and grouted. Rust-joint material was rammed between the casting and masonry after the anchor bolts had been tightened. The new casting was provided with dust caps and automatic grease cups. An especially designed indicator, Fig. 5, with a knife-edge wheel, bolted to the drum and scribing a line on top of the rack, showed that there was no movement of the span after the new pin was in place. This indicator was also used, previous to changing center pins, to determine the way the bridge traveled in turning. (See sketch, Fig. 5, next page.)

To change the center castings, the river traffic was to have been suspended from 1 p.m. Saturday to 6 a.m. Monday. This time was extended to 9 a.m. Tuesday, as a short time after the work was started it was found that the old center pin projected 3 in. below the casting into the masonry. This necessitated cutting a clearance trench in the hard granite to make it possible to slide out the old casting and pin. To do this, it was dis-

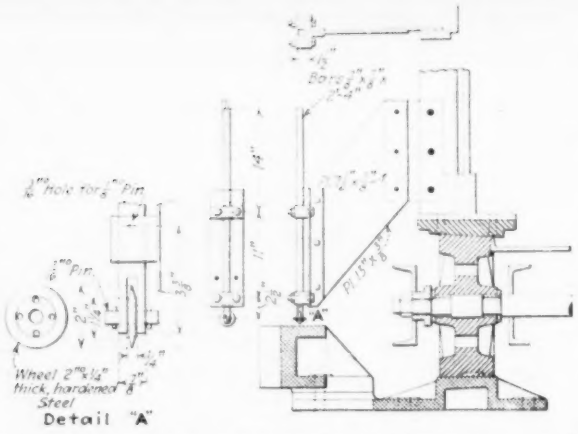


FIG. 5. INDICATOR FOR TESTING MOVEMENT OF SPAN

covered that an oxyacetylene flame chipped the granite quite readily and could be used under the old casting without damaging the rest of the masonry.

Rack Pinions and Driving Machinery Adjusted—To adjust the rack pinions, it was first necessary to repair the supporting brackets. The shifting of the bridge had allowed the pinions to jump out of mesh with the rack with such force that the bracket plates were bent and broken. New bottom plates much longer than the old plates were added to each of the four brackets and riveted to the bottom flange angles and top tread plates of the drum. Also, other reinforcing plates and angles were added with new and much larger bottom bearings for the driving shafts.

The radii and diameters of the rack were found to vary $\frac{3}{8}$ and $\frac{5}{8}$ in., respectively. Also the *greatest* diameter was $\frac{9}{16}$ in. less than that shown on drawings, or that of the pinions. Therefore, the pinion bearings on the brackets had to be planed off $\frac{5}{8}$ in., so that the pinions could be drawn into an established mean pitch line of rack. New collars, set-screws and keys were placed to keep the pinions from riding on the rack.

A number of the driving shafts were badly out of line and, when possible, were lined up and new gears were placed. All the bearing caps were adjusted, many bearings rebabbitted, and washers and keys placed to take up the lost motion. The third and fourth driving pinions added to the bridge in 1912 were no doubt made necessary by the lost motion caused by the variations in the radii of the rack, and the driving machinery not being properly set.

Grinding Top of Bottom Tread—The old live-ring wheels had never been properly adjusted and had run on the outer edge of the bottom tread plate, wearing unevenly the bevel of the plate. Before the new wheels could be drawn into their proper position, it was necessary, therefore, to grind about $\frac{1}{4}$ in. off the inner side of the bottom tread. This was accomplished by installing on the live ring a 10-hp. motor, a water tank, and special grinding machinery operating a 2 x 18-in. emery wheel, and grinding while the bridge was turned. The 65 wheels were then drawn into position and the nuts on the axles were fastened with lock nuts and special lock washers.

The wedges were adjusted to raise the ends of drawspan $\frac{3}{8}$ in. and prevent any hammering from live road. The horizontal shaft operating the wedges, lift rails and latch bars was turned 45°, placing the levers attached to it in a position to give the greatest power, and to lock the wedges. Shims were placed under the top and bottom shoes to wedge the drawspan up level with the fixed spans. The live-load impact caused by the span not being properly wedged had caused the end floor-beams to become permanently deflected $\frac{3}{4}$ in. These beams were reinforced on the drawspan by adding new top and bottom cover plates. Supports were placed under the fixed-span end floor-beams adjacent to the drawspan.

New latch bars were installed, and in placing them account had to be taken of the difference in the elevations of the piers. The east pier is 1 in. lower than the west pier, while the center pier supporting the drawspan is $\frac{1}{4}$ in. low on the east side. When wedges are drawn the west end tilts up 1 in. and the east end down a like amount. However, with the above errors in the elevations of piers it was possible to adjust the latch bars so they would trip when the span was turned end for end. The east fixed span was also found to be $1\frac{1}{8}$ in. out of line with the other two spans, probably due to the settlement of the abutment. The end adjacent to the drawspan was jacked into line.

Providing Clearance for Expansion—Since the abutments were constructed they apparently have been moved by the back fill, as the bottom chords were tight against the masonry and the rollers were out of position, as in Fig. 6. Also, the abutment end dams were tight against the end dams of the bridge and the street-car rails had no expansion joints. The end dams at the drawspan had been moved back several times and the ends of the stringers had been burnt off during hot summer weather to allow for expansion.

These conditions, together with the fact that the east fixed span was out of alignment, might account for the breaking of the original center casting. Binding be-

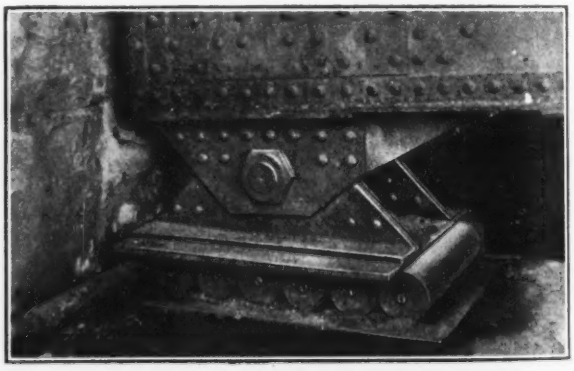


FIG. 6. FIXED-SPAN SHOE TIGHT AGAINST ABUTMENT

tween the east fixed span and the drawspan has always been a source of trouble.

The fixed spans were jacked up and the rollers were cleaned and reset with new anchor bolts, the end dams were reset, expansion joints placed in the street-car rails, and the abutments were cut back by oxyacetylene flame to allow for expansion of the fixed spans. At the drawspan all the end dams were removed and adjusted, being riveted with 1-in. rivets to new heavy beams supporting the buckle plates. (See Fig. 7, next page.) To adjust these end dams to the same clearance at both ends, the indicator used in centering the drum was attached to the end floor-beam of the drawspan and the

bridge was revolved, allowing the wheel of the indicator to cut a sharp line on top of each pier.

The floor system and the bottom chords were cleaned and painted; all gears and bearings were cleaned and automatic grease cups were installed; a lighting system was placed inside the drum, as well as platforms, stairways and oil pans. An indicator showing the exact location of the bridge in opening and closing was placed in the engine room to enable the engineer to control the swing span and avoid breaking the latch bars. Also, a brake was placed on the driving shaft for emergency use.

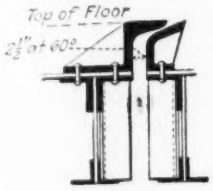


FIG. 7. BEAMS SUPPORT END DAMS

This work was carried out under the supervision of T. J. Wasser, county engineer of Hudson County, New Jersey. The Bethlehem Steel Bridge Corporation had the contract for fabricating and erecting all material. The writer acted as the corporation's erection foreman.

Telescopic Foundation Caissons Sunk in Bank Basement

Support New Vault Weighing 275 Tons—Quicksand Subsoil 45 Feet Deep—Work Did Not Disturb Bank Operations

BY FRANK H. EASTMAN
Foundation Engineer, New York City

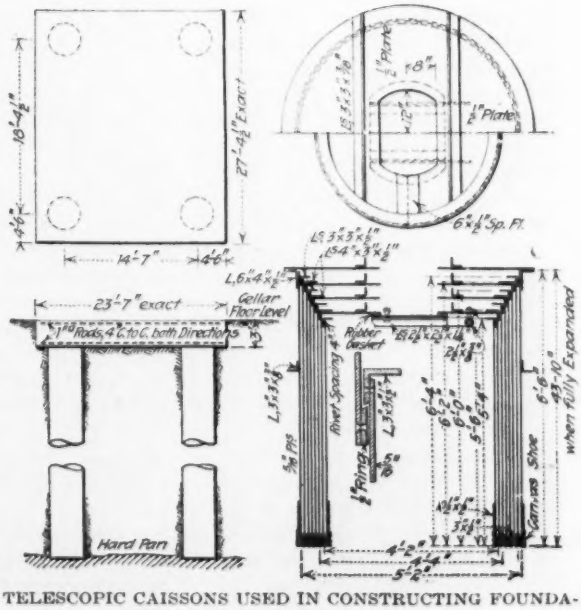
TELESCOPIC compressed-air caissons were used with complete success to make the foundation for a large vault in the basement of the Central Union Trust Co.'s building, 80 Broadway, New York, during the recent remodeling of the bank. Four new vaults were included in the work, the largest of which, 24 x 27 x 20 ft., weighing 275 tons, was so heavy a load that it was desired to found it on hardpan or bedrock as assurance against settlement. Construction had to be carried on in the low headroom and restricted space of the basement, however, and bank operations could not be interfered with; these facts and the danger of disturbing the footings of nearby building columns made the operation delicate and difficult. The William Young Co., contractor, New York City, carried out the work, its consulting engineer on the foundation being T. Kennard Thomson, who designed and constructed the foundation and proposed the use of the telescopic caissons.

Like many similar structures in lower New York, the Central Union Trust building rests on what has been termed a floating foundation, on the soil locally known as New York quicksand. This material has safely supported many fair-sized buildings and can be absolutely relied upon, provided it is not underdrained by subways or deeper excavation. The columns rest on brick piers supported on the quicksand only 1 ft. below the cellar floor. As the vault space would extend close to the footings of these piers on three sides and to the foundations of an existing vault on the fourth side, the sinking of deep foundations presented grave difficulties. Mr. Thomson planned to use a compressed-air system of shaft-sinking which he had used in 1909 for underpinning the Cambridge Building and had patented. In this system the top section of the shaft, constructed in the open, is capped with an air lock, and the shaft below is constructed by excavating in short sections and setting lining plates. This system was chosen for the vault foundations on the assumption that the excavation would be 30 ft. deep. On making borings, however, it was found that the piers would have to go down 45 ft., and Mr. Thomson therefore decided to adopt a modification of his plan patented by the late Ogden Merrill of the firm of Merrill-Ruckgaber Co., which was used by that firm at the New York Assay Office in 1909.

In this method the caisson sections are telescoped, and the sections below the upper or air-lock section are sunk successively by jacking down against the upper section. The method is more expensive than the Thomson shaft method, but avoids the necessity of excavating below the cutting edge to insert the lining segments. The quicksand of lower New York can nearly always be excavated a foot or two below the cutting edge without blowout. Thus, in a recent caisson foundation which the writer inspected, the cutting edge was stopped 2 ft. above hardpan and then 6 or 7 ft. of hardpan was removed without accident. This is probably the only time such a risk has been taken, and in the writer's opinion it should not be repeated. Excavating below the cutting edge in fine sand and clay and leaving a large excavation open for a day or two is a very different matter from excavating under a 4-ft. shaft for a few minutes while a lining plate is being set.

At the Central Union Trust Co. Building the final borings indicated rock or hardpan 62 ft. below street curb and about 45 ft. below cellar floor. Groundwater was found 8 ft. below the cellar floor. It was decided to build the four caissons of eight sections each, the bottom or smallest one being 4 ft. in diameter and 5 ft. 4 in. high (see sketch). The bottom ends of all sections were at the same level when the caisson was fully telescoped.

From the drawing it will be seen that inside the bottom of each section was riveted a band of 3 x ½-in. steel plate with the top edge beveled backward, adapted to engage the beveled edge of a steel angle riveted around the top of the next inner section. Thus, when any



TELESCOPIC CAISSONS USED IN CONSTRUCTING FOUNDATION FOR 275-TON BANK VAULT

section was forced down to its final position, the steel angle at its upper edge would catch on the steel rim plate at the bottom of the next outer section, thus preventing the sections from pulling apart.

Four diaphragms were built for each caisson, for the sake of stiffness and to afford frames for doors, using the cylinders themselves as air locks. When construction work started, however, it was found that 20-ft. headroom could be used, and, as a Mattson air lock was available that could be worked in this space, the diaphragm and doors inside the caissons were not used. This air lock was 4 ft. in diameter by 10 ft. high and had the outside door on the side of the lock.

The specifications called for the caisson sections to be calked against air pressure, but, as a matter of fact, it was necessary to use considerable putty and oakum to make them hold air; and, as this would not hold back water pressure from the outside, all the concreting was done under air pressure. Each section was 2 in. less in diameter than the one above it, so that, as the shell plates were $\frac{5}{16}$ in. and the edging bands $\frac{1}{2}$ in. thick, the theoretical clearance was $\frac{3}{16}$ in. on each side, or a total of $\frac{3}{8}$ in. For similar riveted work (the sections were butt-riveted) the clearance seems ample, while with welded sections less clearance would be needed.

Each caisson was set in a 6-ft. excavation made to receive it, so that the top was slightly below the cellar floor line. Then a trench about 3 ft. wide and deep was made all around and filled with concrete, to hold the caisson down against the air pressure. Four timber struts were set between the top of the caisson and the floor above, as extra safeguards.

Jacks Force Down Caisson Sections

Sinking was done by forcing the caisson sections down by jacks. The whole group of sections inside the first or outer one was shoved down by four 7-ton jacks (4 in. in diameter by 22 in. high) placed between the top of the second section and the inside of the roof of the outer section; until the nest was down far enough to give room for inserting these jacks they were placed between pairs of beams attached to the lower nest and to the air-lock shaft. When sinking had progressed to the point where the angle at the top of the second section came to bearing on the band at the foot of the outer section, four 6 x 6-in. oak struts were inserted to hold down the second section during the subsequent jacking. This process was repeated for the successive stages of sinking until the last section was down and the shaft bottomed in the hardpan.

When the first two caissons were delivered on the job, two 800-cu.ft. compressors were set up over the locations of the third and fourth caissons, with an air receiver over them. When the first two cylinders had been sunk and concreted, the compressors were moved to a position over them, permitting the third and fourth caissons to be sunk without going outside the space occupied by the vaults.

The compressors and the first two caissons arrived on the site Feb. 17, 1919, and air was put on Feb. 22. Eight men were worked in each shift.

Five working days of three eight-hour shifts each were required to complete one caisson shaft. The fourth caisson was completed Mar. 28, and the concrete vault-floor slab, 24 x 27 ft. by 2 ft. thick, was completed Apr. 9.

Excavation spoil was placed in tin pails, hoisted to the lock on top of the caisson and dumped; it was then put in canvas bags and carried out of the building at night. Concrete materials were brought in in the same way. Mixing was done by hand.

The first two caissons gave more or less trouble from jamming, making it quite difficult for the jacks to force the lower sections down. The last two caissons, however, though presumably the same as the first two in every respect, worked very freely, never requiring anything like the full strength of the jacks.

As each section went down, oakum and putty were used to seal all joints. This was found to be a cheap and effective material for sealing. These precautions were vital, for escape of compressed air or the entrance of material from the outside into the working chamber might have endangered the stability of the bank building.

The entire operation was carried on without the slightest accident and without any damage to the building. There was, however, an interesting occurrence during the sinking of the first caisson. The ground-water level suddenly rose about 9 ft. However, the water suddenly dropped back 10 ft. and gave no further trouble. No explanation of the peculiar occurrence was ever obtained. A leak in a water main or an extra high tide and wind might have been responsible. Needless to say, if such changes in the water level occur periodically the foundations of buildings now resting on quicksand may in time be seriously endangered.

The entire work of reconstruction in the Central Union Trust Co. Building was under the supervision of A. A. Macdonald, of the William Young Co., the contractor, and the writer was superintendent in charge for the company for the caisson foundation.

110-Foot Turntable With Adjustable Center

Anticipating the installation of new Mallet engines with 97-ft. 3⅜-in. wheel base, the Pennsylvania R.R. has installed at Pitcairn, South Philadelphia, Erie, Kane and Renovo, Penn., and at Gardenville, N. Y., turntables 110 ft. long. Owing to the excessive depth which would be required for such a turntable if made center-bearing, and also because it is difficult to spot a locomotive of this size and weight with any degree of accuracy, it was decided to construct the turntable as a continuous girder supported at three points, with the weight of the table and its load distributed between the center bearings and the end trucks. Turntable tractors are provided to turn the new tables end for end in 60 sec. Two tractors are provided, either of which is capable of turning the table under emergency conditions. The maximum circumferential speed of the table is 240 ft. per minute. The adoption of a three-point support permitted the use of girders only 6 ft. deep, and reduced materially the depth of pit required. The center support is made adjustable by means of screw-operated wedges, the total range of adjustment being 1 in. The capacity of the center bearing is 860,000 lb., and it is fully grease-lubricated. The motors are equipped with solenoid brakes, which are applied instantly when the controller is turned off, and are released automatically when power is applied.

Hydraulicking Dam Embankment on Miami Flood-Control Project

Glacial Drift Excavated by Draglines, Hauled by Train to Hog Boxes, Mixed With Water and Then Pumped to Dam

ABOUT 9,000,000 cu.yd. of embankment construction is involved in the five retarding-basin dams of the Miami Valley flood-control operations. Not all of this yardage will be hydraulic fill, but so much will be that the work ranks as the largest of its kind. This season is the beginning of pumping, and ways that will later mark proved practice are being slowly worked out. Ultimately, records of hydraulicking will be precise and comprehensive, and a year from now an account of experience will be possible which will advance the definite knowledge of embankment construction of materials carried and deposited by water. Even now some of these lessons are foreshadowed, and a narrative of progress is useful.

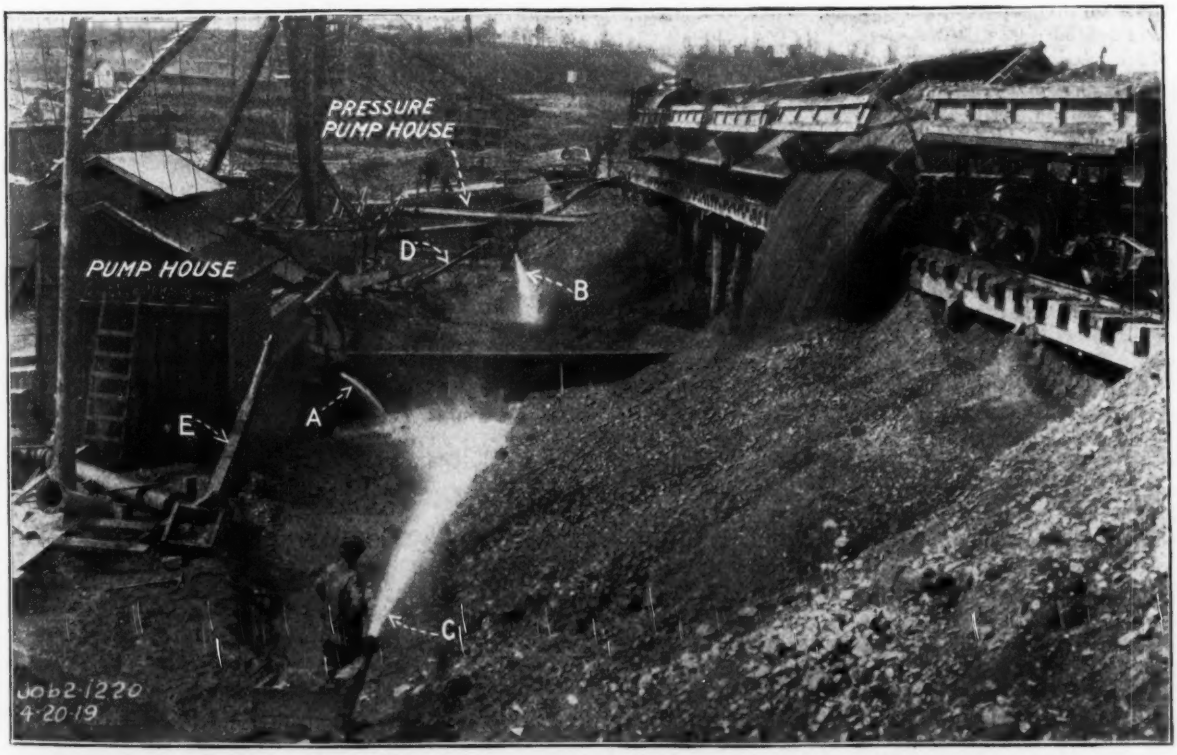
Pumping has not proceeded far except for the dams at Taylorsville and at Englewood. There are about 1,200,000 cu.yd. in one and 3,500,000 cu.yd. in the other. The operations at these two dams, however, illustrate the two methods in handling materials hydraulically. One is to break down, sluice, distribute and deposit the earth wholly by water; the other is to excavate and transport the material mechanically and to employ water merely as the distributing and depositing agency. At all dams except Taylorsville and Lockington the latter method will prevail. It is, speaking generally, the adopted practice of the flood-control work and the special contribution of this work to the practice of hydraulic filling. At Taylorsville and Lockington special circumstances intervene to modify standard procedure.

At Englewood the material for embankment comes from a borrow pit in the valley 250 to 4000 ft. above the embankment. A cut 5 to 25 ft. deep, depending on the material encountered, is excavated over this area, and the material is hauled by trains to the dam, where it is dumped into a pit. From the pit, distribution is by pumping. This pit is called the "hog box," and the hog box is the ganglion of all the operations contributing to the embankment construction. At a conning tower here a trained inspector has every recording gage before his eyes and is in telephone connection with all critical points of the filling operations.

Two dragline excavators traversing the borrow pit area excavate and load to four trains, each having six to eight 12-cu.yd. dump cars and a 46-ton locomotive. The haul by train ranges from 600 ft. to 4000 ft. Two trains serve each excavator, and dump from a trestle into the hog box. The average is approximately 10 cu.yd. per car and 250 cars delivered per 10-hour day.

Operations at the hog box are explained by one of the views. The box is a rectangular structure with a railway track or trestle along one side, and it is located at the upstream toe of and about opposite the center of gravity of the fill. Its floor slopes from the trestle and also from each end to a low point, as at A, on each side of the transverse partition. Here there are gates which control the flow to an 8 x 10-ft. concrete sump covered by two 8-ft.-square grizzlies with 6 x 6-in. openings.

Four monitors, or hydraulic giants, move the materials in the hog box to the sump. Two of these, B and C, one at each end, face each other, and two, D and E, on the opposite side, face the trestle. Except to wash out a load stuck in a car, monitors D and E are seldom used. Two 10-in. pumps working to 135-ft. head



HOG BOX AT ENGLEWOOD TYPICAL OF HYDRAULIC FILLING METHODS AT MIAMI

supply water for the monitors. These pumps are arranged to operate either in series or parallel, but the power is so great that series operation has not yet been required and probably it never will be. Each pump is driven by a 100-hp. motor and has a capacity of 2000 gal. per minute. Any material, except lumps of indurated clay, which receives the attack of the monitor streams, is separated into its integral fragments before reaching the sump, and here the grizzlies remove the stones larger than six-inch.

Two centrifugal pumps, 15-in., pump from sump to embankment. Since the capacity of each of these pumps is 7000 gal. per minute, the monitors do not supply enough water, and the sump is connected by a 48-in. tunnel with the adjacent river. The monitors furnish 20% of the water and 80% is delivered by the tunnel. Each pump requires a 500-hp. motor.

At Taylorsville another set of conditions existed. The bulk of the dam is west of the river, and to form the new river channel and the emplacements for spillway and conduits at the east end of the dam a heavy cut had to be made east of the river. The earth portion of this cut is being pumped into the west embankment.

Embankment construction at Taylorsville is a thoroughgoing hydraulicking operation. The material loosened by blasting, principally on account of a single hard-clay stratum, is disintegrated by giants, sluiced to sumps and pumped into embankment. The equipment comprises three systems of pipes and pumps and two pump houses. The hill being cut down is on the east bank of the river, and the pump for hydraulic fill is located at its foot. This is a 15-in. motor-driven centrifugal pump of 5500-gal. capacity and 80-ft. maximum head. A trestle carries the discharge pipe across the river to the fill. The pump house for the jet pumps and the sluicing water pumps is on the west bank of the river. The jet pumps are two 1400-gal. 265-ft.-head centrifugals operated by 150-hp. motors. Their discharge pipe crosses the trestle to the 2½-in. giants in the cut. Two 5400-gal. 100-ft. head, 150-hp. pumps supply the sluicing water.

The volumes of material now being put into embankment are about 200 cu.yd. per hour at Englewood and 120 cu.yd. per hour at Taylorsville. Two pumps are operating at Englewood and one pump at Taylorsville. The volume of solids is from 7 to 8% of the total volume pumped. At Taylorsville measurements in fill show an increase of 25 to 50% over measurements in cut. Material in the cut is exceedingly dense and compact, and when broken up into its integral particles and redeposited, the coarse sizes at the edges of the fill and the fine sizes in the center, there is naturally a gain in space occupied.

The striking lesson of the pumping operations so far at both dams is the inability of cast-iron pump runners to withstand the wear. After handling 10,000 to 12,000 cu.yd., these runners are worn so as to be useless. Manganese steel runners are being substituted as fast as the old runners are worn out, and ultimately manganese shells will be employed. The new manganese runners show great endurance for the short time they have been operated, and appear to have solved the problem of wear.

The glacial drift of which the embankments are being built up suits hydraulic filling methods very perfectly. The gravelly portions break up and the clay ordinarily melts completely under the action of the jets. On the

GIANT BREAKS DOWN MATERIAL FOR HYDRAULIC FILL AT TAYLORSVILLE

fills the coarse and fine materials grade down well from edge to core. At Taylorsville a stratum of hard blue clay provides a variation from normal. The jets do not melt this clay. It breaks up with difficulty into fragments, which go through the pumps and discharge pipes intact, but are there rolled into almost perfect balls ranging in size from a grape fruit to a marble. These balls are deposited with the stones and pebbles of corresponding size. As there is an oversupply of fine material in the cut the balling up of this particular clay is rather an advantage. Blasting is necessary to insure successful action of the jets on the clay stratum.

Pipe lines are of three materials. For high-pressure lines to the giants, spiral riveted steel pipe is employed. Welded steel pipe delivers the material to the fill, and for sluicing water 18-in. wire-wound wood pipes are employed. At the end of the sluicing pipe in the cut at Taylorsville a 50-ft. length of canvas pipe has proved a decided convenience in quickly changing the direction of flow. At Taylorsville, also, side levees on the fill are built up by fine materials dropped through gates in the bottom of the final hundred feet of the discharge pipe. Similar levee construction at Englewood is being performed by dragline excavators traveling back and forth along the edges of the fill.

Construction and equipment of the hog boxes present two variations in floor structure and two in construction of grizzlies. At Englewood a hardwood floor of 2 x 4-in. stuff set close on edge is employed; at Germantown a 4-in. concrete floor has been built. These floors are

VOLUME OF 200 CU.YD. PER HOUR NOW BEING PUT INTO EMBANKMENT OF ENGLEWOOD DAM

subjected to heavy wear, and comparison of the two constructions promises useful data. At Englewood and Taylorsville the grizzlies or screens over the sumps are fixed, and stones too large to pass are removed by hand. This hand work is hard and disagreeable, and to eliminate it at Germantown a moving grizzly has been installed, which, it is expected, will automatically remove the oversize stones and deposit them in skips. This innovation is being watched carefully; its success will eliminate a disagreeable manual operation.

Hydraulicking methods, and, to a great extent, pump construction, have been worked out by the engineering staff of the Miami Conservancy District, of which Arthur E. Morgan is chief engineer, Charles H. Paul, assistant chief engineer, and C. H. Locher construction manager.

Traversing by a Thirty-Five Minute Angle Method

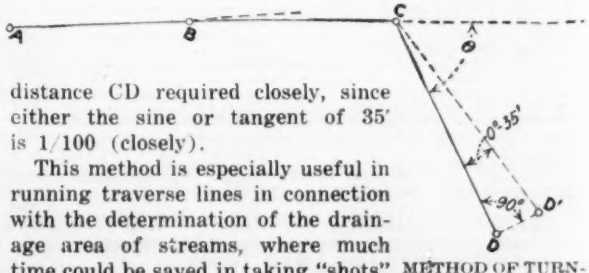
By John H. Sawkins
Schenectady, N. Y.

TRAVERSING by turning a 35′ angle and multiplying the offset by 100 to obtain the distance is a very convenient way to make a survey of this type. It gives results as close as the stadia and is perhaps superior to it, since the computation for distance is so simple. Besides, it is much quicker, especially in rough country, and all the equipment necessary is the transit, a cloth tape and two flagpoles.

The method is suggested by the accompanying sketch and is as follows:

Let ABCD be a portion of a transit traverse line, the *directions* of the lines AB,BC,CD, etc., being determined by deflection angles, as commonly used in railroad surveying. The *lengths* employing the 35′ method would be found as shown for line CD. With the transit at C, backsighted on B, the telescope is plunged and the point D (being selected by the front flagman) is sighted on, deflection angle θ being recorded to the right.

The front flagman then approximates a line DD′ at right angles to CD, and the transitman increasing or decreasing angle θ by *35 minutes*, lines in the flagman, who moves the flag along DD′ to some point at D′. Except for unusually long sights the line DD′ is short, and the approximation on the right angle CDD′ introduces little error. The flagman measures DD′ with a cloth tape, and this length times 100 gives the distance CD required closely, since either the sine or tangent of 35′ is 1/100 (closely).



METHOD OF TURNING ANGLE TO OBTAIN LENGTH OF TIME

This method is especially useful in running traverse lines in connection with the determination of the drainage area of streams, where much time could be saved in taking "shots" several thousand feet along the ridge line or divide. It would be impossible to take "shots" a mile or more in length by stadia, using a convenient length of stadia rod.

Sewage-Treatment Works at Langley Field, Virginia

Imhoff Tank With Receiving Bowls, Inlet Channels, Bar Screen, Distributing Channel With Downtakes —A Dosing Chamber, Ventilated Sprinkling Filters, and Final Settling Tanks to Be Added

By Thorndike Saville
Associate Professor of Sanitary Engineering, University of North Carolina, Chapel Hill

and

Carl L. Weil
Civil Engineer, New York City

UNUSUAL features of the Imhoff tank forming the unit of the Langley Field sewage-works thus far built are bowls and curved inlet channels to receive and break the force of the sewage discharged from the force mains leading from the ejectors, and a channel that distributes the sewage downward into the tank. Ultimately, a dosing chamber, a specially ventilated sprinkling filter and a final sedimentation tank will be added. Provision for possible chlorination of the effluent will be made.

Langley Field is the chief permanent aëronautical station of the United States. It is situated about four miles northwest of Hampton, Va., and occupies some 1769 acres between the northwest and southwest branches of Back River. The portion of the field given over to the town site drains into the southwest branch, a shallow tidal estuary.

The sewage is strictly domestic. There is, however, a considerable quantity of gasoline wastes from garages and hangars. This is a temporary condition, which will be eliminated as more permanent buildings are constructed from which independent drains, well trapped against gasoline, will be provided. The sewage is now partly, and eventually will be entirely, drained into two sets of Shone ejectors, located at opposite ends of the field, which deliver through 6-in. cast-iron force mains to the Imhoff tank.

The disposal plant is situated on a point of land (Fig. 1). The data upon which the Imhoff tank was designed are given in the accompanying table.

The sewage enters the Imhoff tank (Fig. 2) through the two force mains from the ejectors, which discharge into bowls in the screening platform. From these it flows through a curved channel, which is 12 in. wide at the upper end. It decreases to 10 in. at the portion where the screen is set. The screen consisted of four steel bars, ⅜ in. thick, 2 ft. wide and 4¼ ft. long. These were set at an angle of approximately 14° with the horizontal and were spanned 2 in. on centers. Having passed the screen, the sewage flows to the curved distributing trough. In this are six circular openings, 6 in. in diameter, through which it flows into the hopper of the tank.

IMHOFF DATA, LANGLEY FIELD, VIRGINIA

General:	
Population (estimated) maximum	1,800
Average rate of flow, gal. per capita per day	100
Maximum rate of flow, gal. per capita per day	175
Sludge production, cubic feet per capita per day	0.00525
Imhoff tank, type, longitudinal horizontal flow:	
Width (interior), ft.	12
Length of water line (interior), ft.	30½
Minimum depth of water over top of sloping walls of chamber, feet	2.0
Minimum depth of water over slots at bottom walls of chamber, feet	9.5
Depth from top of dividing beam to bottom of sludge chamber	14.5
Total depth, feet	26.0
Number of slots	2
Horizontal width of each slot, inches	8
Clearance of each slot, inches	5
Length at elevation of slots, feet	20
Total capacity below minimum water line, gallons	16,180
Total capacity below ordinary maximum, gallons	16,850
Slope of long walls	1.43 on 1
Slope of long end walls	1.41 on 1
Cross-sectional area of chamber (normal), square feet	76.04
Cross-sectional area of chamber (average), square feet	70.50
Horizontal area, square feet	368.0

Hydraulic data:

Flow in Gallons per Day	Total in Second-Feet	Detention Period	Velocity in Feet Per Second Normal	Velocity in Feet Per Second Average
Mean	175,000	0.272	2.25	0.0040
Maximum	306,250	0.475	1.32	0.0070

Inlet—Six holes each 6-inch diameter in bottom of influent channel.
Outlet, six V-shaped weirs with angles of 90 degrees.

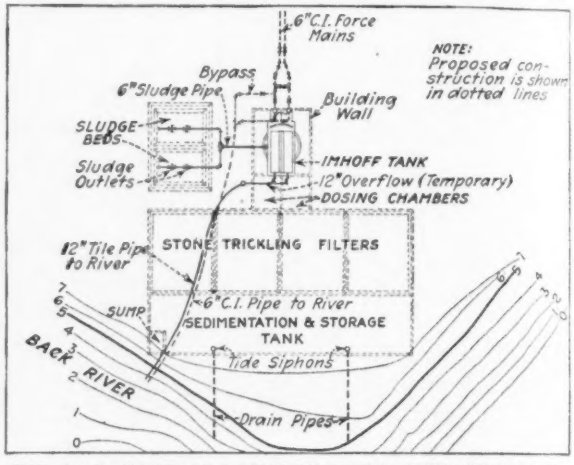


FIG. 1. LAYOUT OF LANGLEY FIELD SEWAGE-WORKS

The hemispherical bowl, into which the sewage discharges, and also the scrolled screening channel, were designed for converting into a reasonably quiet flow the sudden surges of sewage from discharges of the ejectors. This object has been satisfactorily achieved. The head on the ejectors, however, varies, and consequently it has been impossible so to regulate the flow that the sewage shall not spout up over the top of the bowls. This has been remedied by completing the spherical outline of the bowls by a galvanized-iron cover (see detail, Fig. 2). Figure 3 shows the sewage spouting from the uncovered bowl.

The sewage, dropping through the openings in the distributing trough (Fig. 4), falls upon the hopper end of the tank. The solids pass through the slots on each side of the triangular dividing beam, into the sludge-digestion compartment below. This storage space, computed to within 2 ft. of the slots, contains 3060 cu.ft. or 1.7 cu.ft. per capita. Based on a maximum population of 1800 and a contribution of 0.00525 cu.ft. of sludge per capita per day, there is capacity of nearly 11 months' sludge storage. Under conditions likely to obtain for a year or two, the population will not exceed 1,000 and the storage capacity will be sufficient for about 20 months. The sludge chamber will, therefore, have to be cleaned from once a year to once in 18 or 20 months, depending upon the population.

To aid in loosening the sludge when it is desired to pump it out through the sludge-discharge pipe, 2-in. lead water pipes have been placed as shown on section B-B. The sludge will be discharged by gravity under a 4-ft. head onto sludge-drying beds.

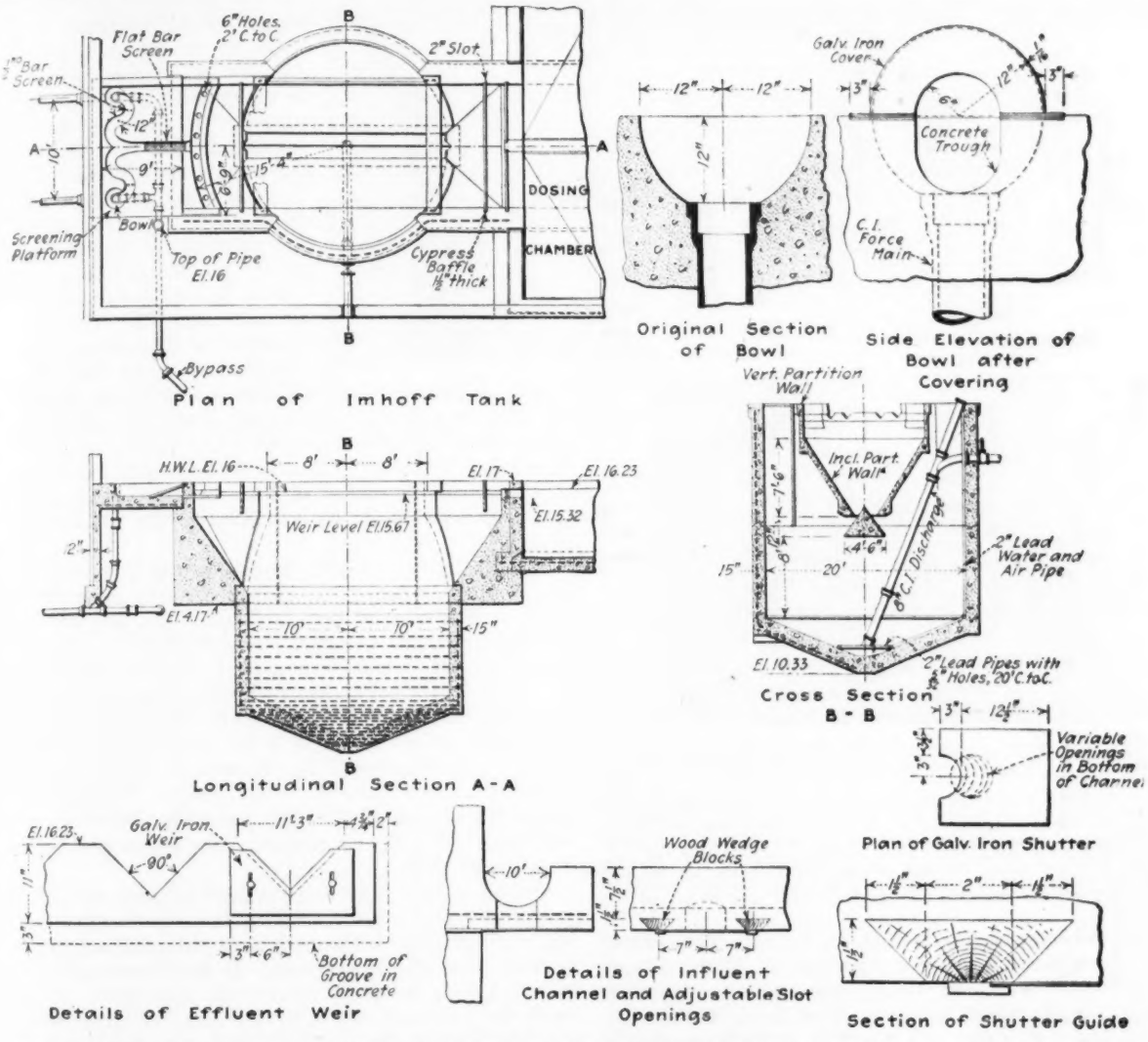


FIG. 2. INLET BOWLS AND CHANNELS, BAR SCREEN, DOWNTAKE DISTRIBUTING CHANNEL AND OTHER IMHOFF TANK DETAILS AT LANGLEY FIELD

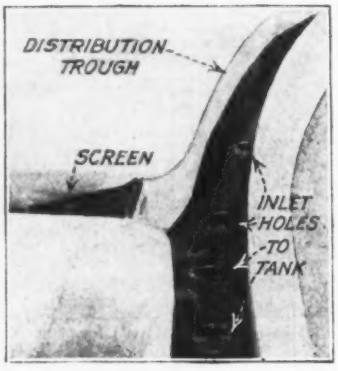
The sludge-drying beds present a total area of 1200 sq.ft. and allow for about 1-ft. depth of sludge. It will be some time before an effective area of 1 sq.ft. per person is exceeded. The beds are so arranged that if population growth makes more beds necessary they can be readily added to the existing beds. The beds as designed are of sufficient capacity to make it unnecessary to draw sludge more frequently than once a month. It is probable that these beds will have insufficient area to dry the sludge during wet months, and two additional beds have been recommended.

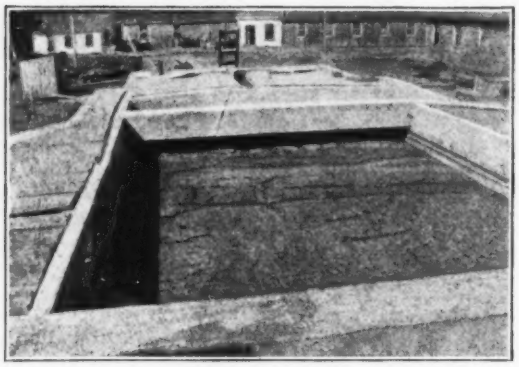
The liquid matter from the sewage flows through the compartment at rates and with detention periods shown in the table. From the settling compartment the liquid effluent passes over two sets of triangular notch weirs into the dosing chamber.

The dosing chamber contains approximately 14,000 gal. This is discharged by four 8-in. Miller siphons operating in pairs and discharging alternately upon each set of filter beds.

The filter beds (Fig. 5) are designed to treat 400,000 gal. per day. They are arranged in two units each of two beds. The units are dosed alternately by means of the siphons in the dosing chamber. The filters are to be of crushed stone, 6 ft. deep. The areas of each filter will be 2500 sq.ft., a total of 0.42 acres. The distribution of sewage is accomplished by means of Taylor nozzles. Nozzles giving a hexagonal spray have been used as providing the best aëration of sewage. These are spaced on a pattern which was devised for square sprays. In this manner it is believed that the best aëration, together with the best distribution, is accomplished.

The area and depth of the filters was determined by various factors. The depth of 6 ft. was all that could be allowed, on account of existing topography, and to attain the required head on the nozzles. The area was based on what was considered good practice, and upon consideration of the nitrogen load. At the Lawrence experimental filters it was shown (Report, Massachusetts State Board of Health, 1908) that for ordinary domestic sewage a nitrogen load of 10 grams per capita per day needed 13.3 cu.ft. per person, and for average sewage, with a nitrogen load of 15 grams per capita per





FIGS. 3 TO 5. GENERAL AND DETAILED VIEWS OF LANGLEY FIELD IMHOFF TANK

Fig. 3 shows incoming sewage spurting up from one of the two inlet bowls, due to the force of the discharge from the ejectors. This bowl was subsequently covered (see detail, Fig. 2). From the bowls the sewage flows through the curved inlet channel to an inclined bar screen, thence to a distributing channel (Fig. 4), from which it drops through circular holes to the Imhoff tank proper. The scum over the tank surface may be seen in Fig. 5, and beyond, the channels already mentioned may be traced.

day, there was needed 20 cu.ft. per person. These filters are designed to care for a population of 4000. Assuming average sewage at 15 cu.ft. per capita per day gives 60,000 cu.ft., which is met by these beds, 10,000 sq.ft. area and 6 ft. deep. As a matter of fact, the sewage is much more nearly domestic than average, and the filters will undoubtedly be able to treat more than 400,000 gal. per day without being overloaded.

Ventilation is obtained in two ways. Four brick chimneys made of hollow brick, with occasional openings, are placed on the center line of each filter unit. In addition, twelve chimneys, made of 6-in. terra-cotta pipe, with down hanging Y's, have been placed at the sides of each filter unit. This method of ventilation is somewhat original and, it is believed, will prove inexpensive and effective.

Distributor pipes are of tile and have been embedded approximately 2 ft. below the surface, both to prevent freezing and secure better distribution in and less clogging of risers. The floor drains are of split tile. Floors pitch at a grade of 1 in 300.

The sedimentation and storage tank is of 100,000 gal. capacity, giving six-hour storage at the maximum rate of flow of 400,000 gal. per day. This tank will remove the suspended matter in the effluent from the filters and will store the effluent to be discharged on the ebb tide. This is necessary because of lack of height in the beds, and is desirable from a sanitary standpoint. The effluent is discharged from the tank by means of a tide siphon, which operates automatically on the falling tide. In case of emergency, such as prolonged high storm tides, provision is made for pumping the effluent by a 300-gal. per minute centrifugal pump. A small chamber serves both as pump well and for applying chlorine for sterilization, should that be desirable.

The Imhoff tank was put in use Jan. 21. The first change was to provide hemispherical tops to the inlet bowls, as already described. The second was to remove the four bars forming the screen in the inlet chamber. These served only to interrupt toilet paper. It is believed that if sticks or other material greater than 2-in. in size should be passed through the ejectors it would be retained above the various holes in the distributing trough.

The sewage comes from the ejectors in a very fresh, highly comminuted state, with practically no settling solids. The rate of flow is 210,000 gal. per day or 175 gal. per capita per day. (March, 1919). Although this is a greatly excessive flow for the type of population here, and it will not be lessened until temporary boilers now used for heating are replaced by the permanent system, yet the flow even now is too slow for the proper operation of the tank. The influent is, under present conditions, more stable than the effluent. These conditions will be remedied as the population increases, as will follow after the completion of the permanent buildings on the field.

The sprinkling filter was designed in place of earlier proposed contact beds, because it was thought that this type of filter would best treat the relatively fresh effluent from the Imhoff tank. In the fresh and comminuted state in which the sewage now comes to the tank, there is relatively little settlement of large solids, and consequently the tank is "ripening" slowly and with very little odor. This is regarded as advantageous. It is expected that when the warmer season comes and the population increases, the tank will treat satisfactorily the larger flow. The effluent from the tank will be still fresher than at present and more susceptible to further treatment by sprinkling filters.

Scum Formed but Finally Broke Up

A layer of scum (Fig. 6) started to form on the tank soon after it was put in operation. In spite of the advice of various visitors to break this scum up or clean it off it was left undisturbed. The tank was apparently operating satisfactorily, with little odor, and the scum finally attained a thickness of 4 to 6 in. The scum was due chiefly to the excessive amount of grease, arising from poorly trapped outlets from mess halls. As more attention was paid to cleaning out grease traps, and as some of the mess halls were abandoned, the scum finally broke up without any action having been taken, and at present exists only as a viscous film not more than ½ in. thick.

As noted above, the effluent from the tank, while fairly clear, is not stable and is more putrescible than the influent. This condition will probably be main

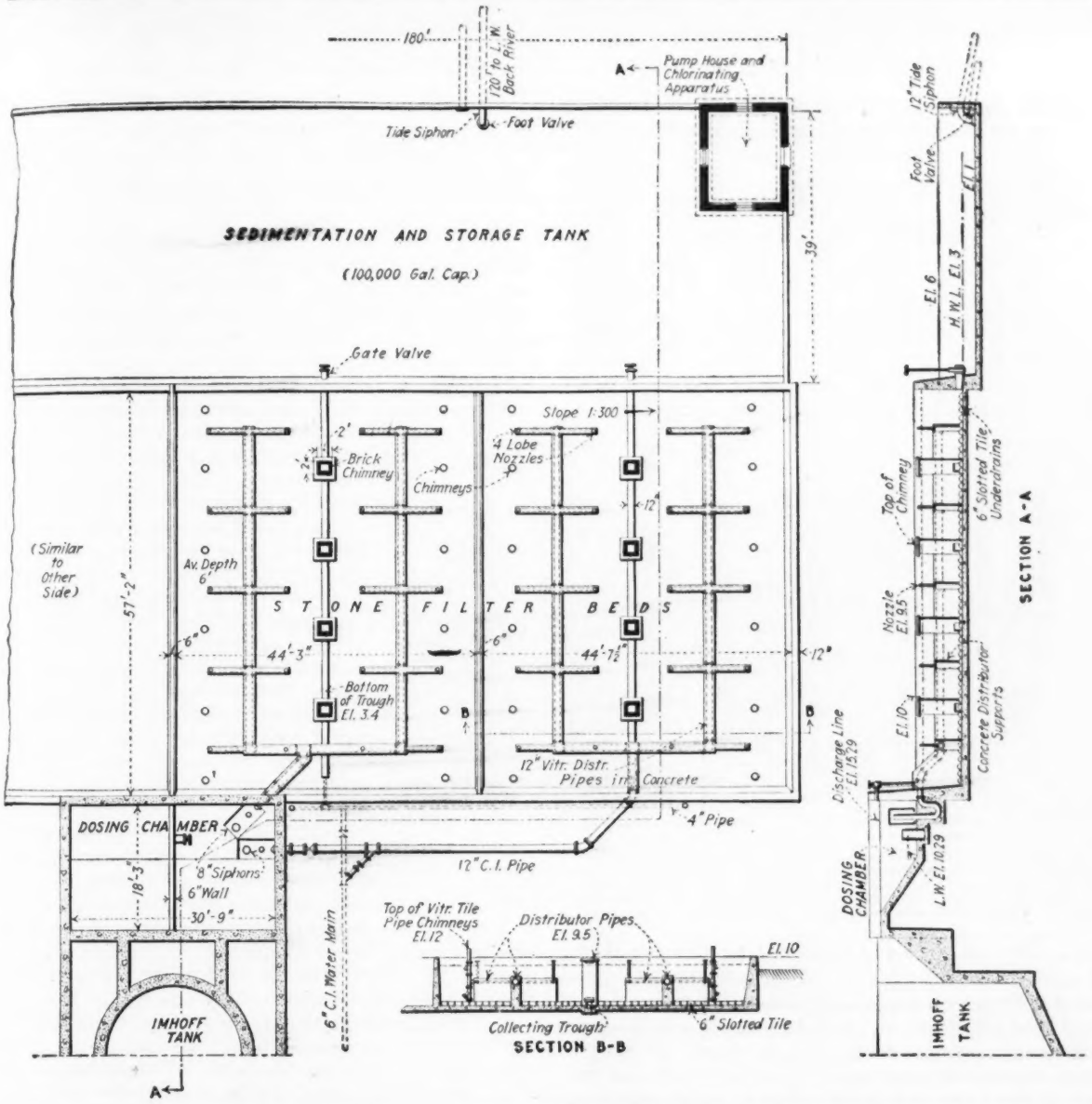


FIG. 6. DETAILS OF SEWAGE SPRINKLING FILTERS, SHOWING THEIR RELATION TO THE IMHOFF TANKS AND THE FINAL SEDIMENTATION AND STORAGE TANK

tained to a less extent even though the population and flow increase. In order to discharge a relatively stable as well as clear effluent into Back River, the sprinkling filters must be constructed as soon as possible. Every indication points to the fact that this combination of Imhoff tank and sprinkling filter will satisfactorily treat the sewage of a population ranging from 2000 to 4000 in number.

The general design of the sewage system and Imhoff tank was made by Ford Kurtz of the J. G. White Engineering Corporation, contractor for the first construction on the field. All of the construction and several changes in design were under the direction of the senior writer. The design of the sprinkling filters and the general plan of the disposal system were made by the writers. Col. William Lay Patterson and Major Howard were the commanding officers of the post during the construction work, and Capt. John McInerney was the officer in charge of construction. The senior writer was officer in charge of water-works, sewerage, and subsoil drainage.

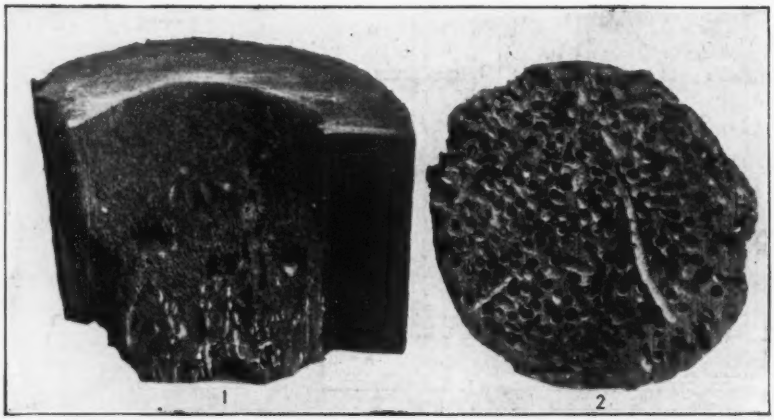
Closing Construction Openings In Dams

In building the 20-ft. reinforced cellular dam of the Rice Rips power plant in Maine, temporary openings were left in the deck. These, when the work was completed, were closed by means of reinforced-concrete slabs, constructed in place on the deck over the openings. Upon the cutting of the supporting cables, when it was desired to fill the pond, the slabs slid into place over the openings, making a permanent water-tight closure. The dam was built by the Central Maine Power Co. under the direction of T. H. Mason, chief engineer, after designs which were prepared by J. A. Leonard.

Creosote Piles Still Sound After 29-Year Service

Seventy Per Cent. of the 14,000 Piles Removed from Oakland Wharf Are Fit for Redriving—Effect of Borers

EFFECTIVE methods of treating wooden piles for salt-water service have become well established on the Pacific Coast, and in recent years there has been little modification of standard practice. Engineers are now agreed on the principles involved, and the dismantling of old wharves seems to check the accepted theories. An excellent example of this was the Long Wharf of the Southern Pacific R.R. on San Francisco Bay, which was removed this spring to make room for port improvements. This wharf consists of a long approach trestle extending out from the shore and terminating in five fingers or docks. It is the oldest creosoted pile structure thus far dismantled on the coast, and contained about 14,000 creosoted piles which have been in service for periods ranging from 18 to 29 years. Data about this structure were included in a general survey of creosoted pile experience on the Pacific Coast, which appeared in *Engineering Record* of July 18, 1914, p. 66.



SHOWING WHAT MARINE BORERS DO TO IMPROPERLY PROTECTED PILES

Left, section of untreated pile after less than two years service; taken from Long Wharf fender where creosoted piles were not used; borings by xylotrya; right, core destroyed by teredo and limnoria; mechanical injury of creosoted shell admitted borers; small holes by limnoria, large holes by teredo.

Of the 14,000 piles in the Long Wharf, interest centers particularly in 600 driven in February, 1890, in the section known as dock A, which supported coal bunkers. These piles, which were of Douglas fir, were well seasoned before being treated with creosote by the Bethel process in the fall of 1889. Records show that under a presure of 200 lb. per square inch and a temperature of 260° F., the piles absorbed 14.17 lb. of creosote per cubic foot. They were then driven by the company's regular crew in the ordinary way, no care being taken to protect them from injury more than was the custom in handling creosoted piles at that time. Of these 600 piles 33 were selected at random for test purposes when the wharf was being dismantled this year. Out of this number 22 (67%) were entirely sound; three (9%) had been slightly attacked by borers; six (18%) had been severely attacked, and two (6%) were so far damaged as to be unfit for further use. These percentages were typical of the entire lot, it is reported, and about 70% of the 600 a.e to be redriven just as they are.

The accompanying table shows the conditions in which piles, driven at different dates, were found:

Location	Date	Number Examined	Practically Intact		Attacked by Borers		Unfit for Redriving	
			No.	Per Cent.	No.	Per Cent.	No.	Per Cent.
Dock C	1897	523	333	64	74	14	116	22
Dock D	1899	1090	829	76	162	15	99	9
Dock E	1901	2485	1900	76	240	10	345	14

After careful examination it is reported that approximately 70% of the entire 14,000 piles are in condition suitable for redriving. The percentage rated as not suitable for redriving showed damage only between the mud line and the high-water mark and the other portions of these piles were in excellent condition.

The results of the very comprehensive and thorough study of piles made on this wharf are believed to confirm the theory that a creosoted pile is absolutely immune from attack of marine borers—whether teredo, limnoria, xylotrya or other varieties active in Pacific Coast waters—so long as the shell or portion of the pile impregnated with creosote remains intact. If the borer can gain access to the inner and untreated core without boring through creosoted wood, it is immaterial whether access be through defect in the wood, crack, knothole, mechanical injury or other means—the effect is the same. Once inside, the borer will work upward and downward in the untreated wood, but in no case have traces of borers been found in the creosoted section. It has been noted that the borings of the teredo cease when they reach a section where the limnoria are working, or, when the limnoria reach a section infested by the the teredo. The reason for this seems to be that the teredo is killed by sea water admitted through the borings of the limnoria.

The announcement that the old Long Wharf was to be dismantled aroused much interest among engineers interested in timber treatment. A delegation which went from Chicago especially to examine the piles represented the American Wood Preservers' Association and the Wood Preservers' Section of the American Railway Engineers' Association. The comprehensive and exhaustive report prepared by this joint committee is to be published for circulation at a later date.

Hay Lines Dam Slopes First Year

Straw or hay is often used as a lining for earth irrigation reservoir dams in Wyoming during the first one or two seasons. The purpose is to permit the fill to settle to a more permanent position before concrete or riprap is put on. The straw or hay is spread rather thickly and covered with chicken wire netting secured to the embankment by stakes. In some cases, stakes are driven before the covering wires are applied, being attached to them so that the wire can be held down close. This is the best practice, according to J. A. Whiting of Cheyenne, who has used the method on several dams. Hay is superior to straw; the latter is brittle and soon breaks up and is floated out by wave action.

ENGINEERING LITERATURE

A REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Book Prices Barred by Postoffice

Through a Postoffice Department ruling, the prices of books reviewed or announced in this section will not be given for the present. Heretofore no pains have been spared to obtain and give these prices, because it was believed they were most useful information.

The Postoffice Department holds that under the zone postage act of Oct. 3, 1917, a book review must be classed as advertising matter, and must be subject to extra postage if the price of the book is given. *Engineering News-Record* would gladly pay the extra postage if that would end the matter, but under the law and ruling it would be compelled to stamp each book review "ADVERTISEMENT," which would be as untrue as "confessions" obtained under duress.

The reasoning of the Postoffice Department is substantially as follows: When publishers of books reviewed in a periodical carry advertisements of the same or other books in that journal, the fact indicates "the presence of a promotive or advertising element in the conduct of the department in which book reviews are inserted" in that publication. But "for the present" the Postoffice Department rules that where it is clear that book reviews are run for the benefit of readers rather than under an agreement with publishers, such reviews need not be classed as advertising, provided the prices are not given.

In other words, after the question is decided on its merits, the whole matter of whether a book review is an "advertisement" or not is nevertheless made to turn on whether the book price is given. Anyone who follows intelligently the book reviews in both technical and literary journals of standing knows that giving or withholding the price is no standard for deciding whether or not a review should be stamped "advertisement." And any such person also knows that the primary function of a book review is information to its readers and the raising of literary standards.

So far as information to the reader is concerned, it is quite true that the most important elements in a review are description and valuation of the book. But the reader also wishes some other facts bearing upon the possible purchase of the volume—such as size, binding, whether illustrated, the publisher and the price. All these the Postoffice Department permits the reviewing periodical to give except the price. The dollar mark brands the review as an "advertisement," even though the review declares that the book is worthless!

But why give the price? The Postoffice Department holds that where reviews are designed solely for the benefit of readers and not to promote sales, prices are "in no way essential to such purpose." Such an opinion is based on a confusion of ideas. Prices afford supplemental information to the reader who wishes to know not only whether the book is a good one, but also whether the price is commensurate with its probable value to him as deduced from the review. Why not give the reader of the review this useful information when it can be compressed within the space of two or three ems? The editor cannot begin to give elsewhere the same amount of useful information in so little space.

We have felt a special obligation to our readers in this matter of price giving, because so many of them are located in out-of-the-way places of this and other countries, without possible access to bookstores. This necessitates writing for prices, unless they are given in reviews or announcements, and writing may mean long delays, with serious inconveniences and professional and money losses. Technical books are for use, not amusement or general culture. The engineer wishes prompt news of their publication, their contents, their probable usefulness to him and their price. For the Postoffice to deny an essential element of this desired and useful information on the plea that price alone determines whether a review is an advertisement is to forbid a useful service for an unjustifiable reason.

Moreover, while the prices of books in many other fields—as fiction—are fairly well standardized, technical books vary widely in price and are often so costly as to make the element of cost largely controlling in determining whether an engineer shall buy a given new book. It is at the moment of reading the review that the reader of the review wishes to know the price, while all the other data are in mind.

Another point in the argument advanced by the Postoffice Department demands attention. In support of its ruling it states that two books reviewed in given issues of *Engineering News-Record* were announced both previously and subsequently in the advertising columns of the same journal. But it did not go far enough to ascertain, as it might have done by consulting the card index of our Engineering Literature section covering 18 years, that of the thousands of books reviewed only a small per cent. were ever advertised in the accompanying advertising pages, and that but few of the publishers of those books have even once used those pages in all that time. Moreover, many of the book notices in our Engineering Literature section are signed by outside reviewers, contributed by more than two hundred men, all of whom hold perfectly free pens in writing their reviews.

The sum and substance of the whole matter is that the readers of *Engineering News-Record*, and of scores of other periodicals as well, are denied highly useful information that can be conveyed in the fraction of a line, because of an arbitrary and unjust Postoffice Department ruling which makes the dollar mark in a book review the sole criterion of whether the review shall be classed as an "advertisement."

Test and Specification Data

TABLES OF MECHANICAL PROPERTIES OF MATERIALS—Washington, D. C.: Bureau of Standards. Paper; 8 x 10 in.; pp. 51.

Published in mimeographed form, this table of data on materials is intended to be revised from time to time. Test data and figures fixed by specifications are brought together in the table. Fifteen pages deal with ferrous metals. A somewhat larger space gives strength

data (hardness) for aluminum and its alloys and for copper alloys and miscellaneous metals. Finally, there are three pages on rubber, leather, and manila rope. The table is a useful list of reference data, though hardly as complete as might be desired—as indicated by the summary of subjects covered—and weak, in particular, on iron. It may be hoped that after some revision on the basis of experience it may be put out in printed form.

Boiler Feed-Water Reactions

REVIEWED BY GEORGE CHANDLER WHIPPLE
Professor of Sanitary Engineering, Harvard University

BOILER CHEMISTRY AND FEED-WATER SUPPLIES—By J. H. Paul, B.Sc., F. I. C., Consulting and Analytical Chemist. New York and London: Longmans, Green & Co. Cloth; 6 x 9 in.; pp. 242; illustrated.

This is a thorough discussion of the chemical reactions which are supposed to take place in a boiler, but most chemists will regard these reactions as fictitious and unsound. The idea which runs through the book is that the reactions between iron and carbonic acid and the carbonates result in the formation of such organic substances as formic acid, acetic acid, formaldehyde, etc., but the experiments offered in proof do not appear to be adequate or conclusive. That not all corrosion is due to dissolved oxygen, but that the water itself contributes oxygen by direct reaction with the iron at high temperatures, is well known, and it is not necessary to resort to the author's theory of organic acids to explain it.

In spite of this fanciful theory, the book contains some excellent material, with many analyses of boiler waters, and boiler scales and sludges. The results are all expressed in terms of combined acids and bases. No use is made of the new ideas of physical chemistry. One word of caution should be given. The author uses the term "free carbonic acid" to mean what is now commonly described as the "half-bound carbonic acid."

The book cannot be regarded as a sound treatise to be placed in the hands of engineers who do not understand chemistry.

Delaware River Bridge-Location Studies

DELAWARE RIVER BRIDGE AND TUNNEL COMMISSION: Report, 1919, to the Governor and General Assembly of the Commonwealth of Pennsylvania. Philadelphia, Penn.: The Commission, City Hall. Cloth; 7 x 10 in.; pp. 45; illustrated.

A notable study by Prof. Warren P. Laird, professor of architecture at the University of Pennsylvania, constitutes the body of this report. Thorough and keen massing of the traffic considerations which should influence the detail location of a bridge across the Delaware at Philadelphia is represented. In this field of bridge location our literature is scanty indeed, and the present report enriches it by a document of high value.

On Government Contracts

THE LAW OF GOVERNMENT CONTRACTS—By R. Preston Shealey, LL.M., Member of the Bar of the Supreme Court of the United States and of the District of Columbia. New York: Ronald Press Co. Cloth; 6 x 9 in.; pp. 300.

Possibly the greater usefulness of this volume to manufacturers and contractors who engage to supply materials to or to perform construction work for Uncle Sam will be in the general impression which will be gained that Federal contractual relations are sufficiently involved to require caution in fixing prices, promising delivery and discounting prompt payment. As a digest of the laws relating to Government contracts the book, so far as the layman in law may judge, is complete. A contractor for Government supplies or construction should read it to acquaint himself with its contents, place it convenient for reference when occasion for decision in any matter of contract agreement becomes necessary—and then play safe by calling in competent legal advice. The last statement is not uttered in sarcasm; it is added because the ramifications of Government authority and procedure in contractual relations are too many for the layman to evaluate correctly with only the aid of book instructions, however good that book may be.

The book consists of five parts—on Definitions, Implied Contracts, Performance, Breach and Procedure—and of four appendixes, the last a reprint of statutes relating to contracts with the United States. As previously stated, each part can be read to advantage, but if any parts are to be selected for special reading they may well be the section on Procedure and the appendix on Practical Suggestions. Special merits of the book are that, so far as may be, it is written in the language of the business man and not of the lawyer, and that it contains a good index.

Another Miami Technical Report

CONTRACT FORMS AND SPECIFICATIONS: With Atlas of Selected Contract and Information Drawings, to Accompany Part VI, Contract Forms and Specifications—By the Engineering Staff of the Miami Conservancy District. Dayton, Ohio: The District. Paper; 6 x 9 in.; pp. 192; illustrated.

Many engineers will welcome the opportunity afforded to obtain the standard contract forms and specifications for the dams and channel improvements of the great flood-protection works being executed by the Miami Conservancy District. The atlas contains 139 representative selections of plans made preparatory to letting contracts, and will also be widely appreciated.

The Draftsman as an Engineer

THE DRAFTSMAN—By Robert W. Shelmire. Chicago: The Scientific Publishing Bureau. Cloth; 5¼ x 8¼ in.; pp. 94.

That the draftsman is an engineer, that he should have more recognition and higher pay, and that organization is the only way in which he can secure such advancement, are the ideas presented by the author, but as to organizing he says, "the union method is beneath the intelligence of draftsmen." Working conditions and office management are discussed mainly in regard to unsatisfactory and undesirable practice. It would seem that more might have been said as to the better grades of offices, which probably are not so few as might be implied from the book. Employment, compensation and patents are other subjects taken up. The book deals with the social and business aspects rather than the technical side of the draftsman's occupation, and seems to bear rather heavily on existing unfavorable conditions, as a basis for advocating the adoption of higher standards and better methods on the part of the employers.

Taking Labor Into Partnership

INDUSTRIAL GOOD-WILL—By John R. Commons, University of Wisconsin. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 213.

Starting with the old theory that labor is a commodity, and its historical successor, that labor is a machine, the author speedily reaches his main thesis of industrial good-will as the solution of current problems of labor and capital. Good-will is treated primarily

in its relation to labor turnover, but the author is not confined to so narrow a conception.

Having considered employee and employer, the relations of both to the broader interests of the public are taken up. Next there is a chapter on "Democracy," in which the author urges that neither the individualism of the French revolutionists nor, at the other extreme, the class socialism of the Bolshevists, is truly democratic, but that all interests must be represented in settling our industrial problems, in accordance with the principles of representative government. Workmen's compensation, security of employment and wages, insurance, health, shop committees, education, loyalty, personality, and the special labor problems incident to industrial depressions, are each and all reviewed. In his concluding chapter, "The World," the author summarizes briefly and forcibly his opinions as to why the predictions announced seventy years ago by Karl Marx and his fellow Socialists in their "Communist Manifesto" have not come true.

The book is a concise, closely reasoned discussion of some of the great labor, social, industrial and governmental problems of the day. The style is so clear and the discussion so brief that the book can be easily read in an hour or two. The author is well known among economists, labor leaders and publicists for his long, keen and discriminating studies in the fields of labor and economics.

Electric Power Transmission

ELECTRIC POWER TRANSMISSION: Principles and Calculations; Including a Revision of "Overhead Electric Power Transmission"—By Alfred Still, Professor of Electrical Design, Purdue University; Member of the Institution of Electrical Engineers, Etc. Second Edition, Revised and Enlarged. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 407; illustrated.

The addition of a chapter on underground conduits has led to a change of title in the present edition of this book. The first edition, entitled "Overhead Electric Power Transmission," was reviewed at length and, in general, favorably, by C. D. Gray in *Engineering News* of Nov. 13, 1913, p. 996. In the present edition much of the material presented in the original issue has been replaced by new material, and portions of the appendixes to the first edition have been incorporated in the text. Some of the changes seem to be in line with suggestions made in the review by Mr. Gray already mentioned.

Holding Laborers

LABOR TURNOVER, LOYALTY AND OUTPUT: A Consideration of the Trend of the Times as Shown by the Results of War Activities in the Machine Shops and Elsewhere—By Fred H. Colvin, Associate Editor *American Machinist*, M. Am. Soc. M. E., and Franklin Institute. New York: McGraw-Hill Book Co., Inc. Cloth; 5 x 8 in.; pp. 152; illustrated.

Labor turnover of the factory and not of the construction job is discussed in this little book. There is, however, enough similarity at points between the two kinds of employment to command the interest of the construction manager in what the author has to tell of the means adopted to stabilize factory labor. It is the thesis of the author that efficiency—including, among other things, a stable working force—is directly proportional to the interest of the workman in his work. To create and maintain this intense interest is, consequently, the prime task of the works manager in the direction of efficiency engineering. The author develops his thesis in the first three chapters, entitled "Lack of Interest and Labor Turnover," "Building an Organization," and "Forgetting the Human Element," and in doing so makes an excellent case against the once numerous efficiency experts who gave their chief attention to dehumanizing production processes.

In the succeeding chapters, entitled "Securing Interests by Instruction," "Instruction in the Shop," "Non-financial Incentives," "The Employment Manager," "Latest Ideas of Leading Men," and "Collective Bargaining," examples are given of methods employed to arouse interest and develop loyalty. These examples are from shop management, but the fundamental principles which they demonstrate are common to industry, including engineering construction. The construction manager will find but little in this book which he can apply directly in his operations, but he will find a number of broad policies, stated very broadly, which he can work over to suit his different needs.

Castigliano Translated

ELASTIC STRESSES IN STRUCTURES: Translated from Castigliano's "Theorem de L'équibre des Systemes Élastiques et Ses Applications"—By Ewart S. Andrews, B.Sc., Eng. (Lond.) Consulting Engineer, etc. London: Scott, Greenwood & Son. New York: D. Van Nostrand Co. Cloth; 7 x 10 in.; pp. 360; folding plates.

A translation of Castigliano's epoch-making work, published forty years ago, is here made available in the English language for the first time. The translator has endeavored to render the original accurately, with a change only in the mathematical notations. The work develops stress calculations for various types of framed structures by the method of least work. In practice, there has been no place for the application of this method to ordinary stresses, statically determined. Therefore, a great deal of the author's teachings and illustrations will prove to have little practical value. Its instructional and inspirational value, of course, is still great, and on this score the book deserves a place in every technical library that aims to give representation to analytical science.

Railways of India

HISTORY OF INDIAN RAILWAYS, Constructed and in Progress; Corrected up to Mar. 31, 1918. Simla, India: Railway Board. Paper; 8 x 13 in.; pp. 249.

This might more appropriately be called "Histories of the Indian Railways," since it gives statistical facts and figures for each railway, but it is in no sense a history of the railway system of India and contains no general summary or description of that system or its operation. It seems doubtful that the character of the information warrants the term "history" even as to the individual systems, and this information relates mainly to the period since each line was taken over by the Government. The railways are classified by width of gage and listed alphabetically for each class, except that some narrow-gage branches are listed with their broad-gage parent lines.

The information includes the length and date of opening of each line (or of the various sections of large systems) and the series of contracts with the Government as to operation and finance, together with statistical tables of earnings and expenses. Brief notes are given as to ruling grades, sharpest curves and construction of track, but no mention is made of structures, equipment or traffic. The "history" must be classed as an official "dry-as-dust" publication of little interest to any but those connected with or having business relations with the railways of India.

PUBLICATIONS RECEIVED

Under a Postoffice Department ruling made applicable to *Engineering News-Record* in July, 1919, it is no longer possible to give the prices of new publications announced under this head or of books reviewed in the preceding columns. Readers will therefore have to obtain this information as best they can. Most of the public documents and of the pamphlets announced may be obtained free on application, or at least by paying postage. So far as possible, the name and address of the publisher of each book and pamphlet are given in each entry.

ABRASIVES & ABRASIVE WHEELS: Their Nature, Manufacture and Use; A Complete Treatise on the Manufacture and Practical Use of Abrasives, Abrasive Wheels and Grinding Operations—By Fred B. Jacobs. New York: The Norman W. Henley Publishing Co. Cloth: 6 x 9 in.; pp. 338; illustrated.

AN AMERICAN LABOR POLICY—By Julius Henry Cohen, Author of "Law and Order in Industry," "The Law: Business or Profession?" "Commercial Arbitration and the Law." New York: The Macmillan Co. Cloth; 5 x 8 in.; pp. 110.

ANALYSIS OF BABBITT—By James Brakes, Chief Chemist, Chateaugay Ore & Iron Co., Member of the American Chemical Society, etc. Troy, New York: Allen Book & Printing Co. Cloth; 5 x 7 in.; pp. 169.
Designed to place before the mining, civil, electrical and mechanical engineer, and others who have had chemical analytical training, a small practical book on the analysis and manufacture of babbitt.

APPLIED CALCULUS: Principles and Applications; Essentials for Students and Engineers—By Robert Gibbes Thomas, Professor of Mathematics and Engineering at The Citadel, The Military College of South Carolina. New York: D. Van Nostrand Co. Flexible Cover; 5 x 8 in.; pp. 490; illustrated.

BIBLIOGRAPHY OF PETROLEUM AND ALLIED SUBstances in 1916—By E. H. Burroughs. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 159. 20c. from Superintendent of Documents.

BURNING STEAM SIZES OF ANTHRACITE WITH OR WITHout admixture of soft coal: Reprint of Engineering Bulletin No. 5; Prepared by the United States Fuel Administration in Collaboration with the Bureau of Mines. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 8; illustrated. 5c. from Superintendent of Documents.

CALIFORNIA BOARD OF STATE HARBOR COMMISSIONERS: Report, 1916-18, Submitted by the Commissioners, Arthur Arlett, President; John H. McCallum, Harry H. Cosgriff. San Francisco, Calif.: The Board. Paper; 6 x 9 in.; pp. 116; illustrated.

CANAL STATISTICS FOR THE SEASON OF NAVIGATION, 1918—Ottawa, Can.: Department of Railways and Canals. Paper; 6 x 9 in.; pp. 33.

CHAMBER OF COMMERCE OF THE UNITED STATES: Seventh Annual Meeting, May 1, 1919. Washington, D. C.: The Chamber. Paper; 6 x 9 in.; pp. 80.

COMMENTS ON THE RAILROAD PROBLEM—By Robert S. Lovett, President, Union Pacific System. New York: The Author. Paper; 5 x 8 in.; pp. 76.

COMMERCIAL POLICY IN WAR TIME AND AFTER: A Study of the Application of Democratic Ideas to International Commercial Relations—By William Smith Culbertson, Member of the United States Tariff Commission; With an introduction by Henry C. Emery, Sometime Chairman of the Tariff Board. New York and London: D. Appleton and Co. Cloth; 5 x 8 in.; pp. 418.
Broadly speaking, this book (1) reviews the effect of the war on American industries that enter foreign trade; (2) discusses the commercial policies of the United States with special reference to the tariff and to national control of our foreign commercial activities; (3) and, finally, it considers world commercial policies, ending with the chapter headed "Towards World Democracy." The author believes that nationalism and internationalism are both essential and should be complementary, not antagonistic.

CONNECTICUT PUBLIC UTILITIES COMMISSION: Report, 1918. Hartford, Conn.: The Commission. Cloth; 6 x 9 in.; pp. 684.

A CONTRIBUTION TO THE HYDROLOGY OF THE SAN LUIS Valley, Colorado—By William P. Headden. Reprinted from the "Proceedings" of the Colorado Scientific Society, Vol. XI, pp. 223-238. Denver, Colo.: The Society. Paper; 6 x 9 in; pp. 14.

COST KEEPING FOR SMALL METAL MINES—By J. C. Pickering. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 46. 10c. from Superintendent of Documents

DISABLED SOLDIERS' AND SAILORS' PENSIONS AND Training—By Edward T. Devine, Professor of Social Economy, Columbia University; Assisted by Lilian Brandt. (Preliminary Economic Studies of the War No. 12, Carnegie Endowment for International Peace) New York: Oxford University Press. Paper; 7 x 10 in.; pp. 471.

EMPLOYMENT MANAGEMENT, EMPLOYEE REPRESENTAtion and Industrial Democracy: Address Delivered before the National Association of Employment Managers, Cleveland, 1919. Washington, D. C.: U. S. Department of Labor. Paper; 6 x 9 in.; pp. 15.

ILLINOIS HIGHWAY IMPROVEMENT BLUE BOOK: A Reference for Illinois Highway Officials, and a Guide for other States That Desire to Copy "The Illinois Plan." Chicago, Ill.: Illinois Highway Improvement Association. Paper; 6 x 9 in.; pp. 136; illustrated.
Contains a complete description of the methods used in promoting state highway-aid legislation in Illinois and in winning votes for a $60,000,000 bond issue.

AN INVESTIGATION OF THE LOUSE PROBLEM—By William Moore, B.A., Associate Professor of Entomology in the University of Minnesota, and Arthur Douglass Hirschfelder, M.D., Professor of Pharmacology in the University of Minnesota. Research Publications of the University of Minnesota. Minneapolis, Minn.: The University. Paper; 7 x 10 in.; pp. 88; illustrated.
A wartime study which may be useful to medical officers and sanitary engineers in charge of contractors' and other camps.

AN INVESTIGATION OF THE STRESSES IN THE TRANSverse Bent for Steel Mill Buildings—By C. S. Sperry. Reprinted from the "Proceedings" of the Colorado Scientific Society, Vol. XI, pp. 253-268. Denver, Colo.: The Society. Paper; 6 x 9 in.; pp. 14; illustrated.

MINING OPERATIONS FOR GOLD, COAL, ETC., IN THE Province of British Columbia: Report of the Minister of Mines, 1918. Victoria, B. C., Can.: The Minister. Paper; 7 x 10 in.; pp. 510; illustrated.

NATIONAL DEPARTMENT OF PUBLIC WORKS: Proceedings of Conference Called by Engineering Council, Apr. 23-25, 1919, Chicago, Ill. Address The Council, 29 W. 39th St., New York City. Paper; 6 x 9 in.; pp. 112.

A NATIONAL LUMBER AND FOREST POLICY—By Henry S. Graves, Chief Forester, Forest Service. Address before the American Lumber Congress, Chicago, Apr. 16, 1919. Washington, D. C.: U. S. Department of Agriculture. Paper; 6 x 9 in.; pp. 14.

ONTARIO HYDRO-ELECTRIC POWER COMMISSION: Annual Report, 1918. Toronto, Can.: The Commission. Paper; 7 x 10 in.; pp. 319; illustrated.

PACIFIC PORTS: Annual Number, 1919, Fifth Edition. Seattle, Wash.: Pacific Ports, Inc. Flexible Cover; 8 x 11 in.; pp. 550; illustrated.
Information of value to shippers at all of the ports of the Pacific, in every country, are given in this annual. Further data on exports and the export business make up the remainder of the book.

PHYSICAL AND CHEMICAL TESTS ON THE COMMERCIAL Marbles of the United States—By D. W. Kessler, Assistant Engineer Physicist, Bureau of Standards. Washington, D. C.: Bureau of Standards. Paper; 7 x 10 in.; pp. 53; illustrated. Copies free upon request from the Bureau of Standards.

PRACTICAL APPLICATION OF THE METHODS RECENTLY Discovered for the Control of the Sprinkling Sewage Filter Fly—By Thomas J. Headlee, Ph.D., Entomologist of the New Jersey Agricultural Experiment Stations and State Entomologist. New Brunswick, N. J.: The Author. Paper; 6 x 9 in.; pp. 5; illustrated.
Enlarges somewhat, chiefly from the entomological side, information given by the same author in *Engineering News-Record* of Sept. 19, 1918, p. 533.

RAILWAY NATIONALIZATION IN JAPAN: Report, 1907-17, of Ten Years' Progress Under State Management. Tokyo, Japan: Imperial Government Rys. of Japan. Paper; 8 x 12 in.; pp. 206; illustrated.

SAFETY IN THE CONSTRUCTION AND USE OF LADDERS—By R. T. Solensten, Assistant Secretary, National Safety Council. Madison, Wis.: Industrial Commission of Wisconsin. Paper; 6 x 9 in.; pp. 16; illustrated.

SIXTH NATIONAL FOREIGN TRADE CONVENTION, REport, 1919. New York: National Foreign Trade Convention Headquarters. Cloth; 6 x 9 in.; pp. 649.

STONE IN 1917—By G. F. Loughlin and A. T. Coons. Washington, D. C.: U. S. Geological Survey. Paper; 6 x 9 in.; pp. 67.

A TEXT-BOOK OF HEAT AND HEAT ENGINES: Specially Arranged for the Use of Engineers Qualifying for the Institution of Civil Engineers, Etc.—By Andrew Jamieson, M. Inst. C.E., formerly Professor of Engineering in the Royal Technical College, Glasgow. Vol. I. Eighteenth Edition, Revised by Edward S. Andrews, B.Sc.Eng. (Lond.) London, Eng.: Charles Griffin & Co., Ltd. Cloth; 5 x 8 in.; pp. 551; illustrated.
In the present revision of this textbook, two volumes were deemed necessary on account of increased size. Thermo-dynamics, entropy, steam boilers and turbines and internal combustion engines have been left for Vol. II, now in preparation.

TIMBER: Its Strength, Seasoning, and Grading—By Harold S. Betts, M.E., Forest Service, U. S. Department of Agriculture. New York: McGraw-Hill Book Co., Inc. London: Hill Publishing Co., Ltd. Cloth; 6 x 9 in.; pp. 234; illustrated.

TREE TELEPHONY AND TELEGRAPHY—By Maj. Gen. George O. Squier, Chief Signal Officer, U. S. A., Member of the Institute. Reprinted from the *Journal of the Franklin Institute*, June, 1919. Philadelphia, Penn.: J. B. Lippincott Co. Paper; 6 x 9 in.; pp. 30; illustrated.

TWELFTH STREET, ST. LOUIS' MOST NEEDED COMMERcial Thoroughfare—By Harland Bartholomew, Engineer, City Plan Commission, St. Louis, Mo. Paper; 8 x 11 in.; pp. 15; illustrated.
Outlines a street-widening project for the benefit of a large part of the population of St. Louis, and shows proposed assessment area for distributing the cost.

VERMONT MINERAL INDUSTRIES AND GEOLOGY, 1917-18: Report of George H. Perkins, State Geologist and Professor of Geology, University of Vermont. Burlington, Vt. Cloth; 6 x 9 in.; pp. 247; illustrated.

WISCONSIN HIGHWAY MAINTENANCE: Devoted Especially to Patrol Maintenance on the State Trunk Highway System—Compiled by J. P. Donaghey, Maintenance Engineer, Wisconsin Highway Commission. Madison, Wis.: The Commission. Paper; 6 x 9 in.; pp. 95; illustrated.
Designed for patrolmen and maintenance foremen, with special reference to earth roads. Much of the information given follows about the same lines as that presented in an article by A. R. Hirst, state highway engineer of Wisconsin, in *Engineering News-Record* of Dec. 10, 1918, p. 1128.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

Illinois Brick Paving Specifications

Sir—On Apr. 23, 1919, the Illinois State Highway Department asked for bids for the construction of the unfinished sections of the Lincoln and Dixie Highways. Competitive bids were asked on concrete, brick, and bituminous macadam on a concrete base. No bids were received on brick, and the work was let for concrete construction. The question naturally arises, Why were no bids received on brick?

It is believed that a partial explanation of this condition can be found in the specifications themselves, as described in an article by the Illinois State Highway Engineer in *Engineering News-Record* of May 8, 1919, p. 905. It is there disclosed that Illinois has exclusively adopted the *rigid* type of construction as the standard for its primary-road system, and that the basis for this standard is "a concrete slab, 7 in. at the side and 8 in. at the center for 16- to 18-ft. widths." The only other types considered as suitable for this system are "monolithic brick" and "bituminous concrete on a concrete base." The nonrigid designs of brick and other pavements are barred. Brick, therefore, to be admitted in the Illinois program, must come in by way of one design, monolithic.

Considering the letting mentioned, and the engineer's paper, I should like to present three questions: (1) Is it wise to commit the state program to the rigid type of pavement? (2) If the rigid type is to be adopted, is it not designed too strong? (3) Were competitive bids on the several materials asked for on a fair basis?

Rigid Pavements

The action of the elements—contraction and expansion from temperature, and moisture changes—must be considered, especially in rigid pavements. After all our experience, is it safe to say that a general rule can be adopted to prevent damage from such causes? It is evident that no general design to overcome such stresses can be adopted, because the conditions are so many and varied. The slab is chemically bonded together as one stone. This composition is sensitive to thermal stresses and the impact of traffic. If the aggregates are uniformly hard, and the concrete mix is of the same quality throughout the slab, it can stand its own expansion and contraction better. The selection of aggregates, therefore, is of great importance. In speaking of rigid types, whether monolithic brick or concrete, they should be regarded as one, for in principle of construction and rigidity they are the same. To increase the depth of the slab does not prevent shrinkage cracks—perhaps only retards the action.

If there were not in existence thousands of miles of gravel, asphaltic-macadam, crushed-stone and Tarvia roads, and highways composed of brick laid on compacted gravel or broken stone, all doing good service, and having only one fault, then this theory of pavements (rigid, and rigid only) might be more nearly correct. The fact is, the universal road of the world is a flexible pavement. The "one fault" above mentioned is its lack of durable wearing surface.

Observe the heavily traveled roads through South Chicago, Hammond and Gary, leading through the steel district. The well graded roads shed the water to the side; there are ample ditches—yet the roads wear out. They do not break through and sink under traffic for lack of "beam strength." They go into holes because the aggregate is either ground to pieces or kicked out of place by traffic. It is the surface which fails, not the base. The base, like the ballast under the railroad, is porous and self-draining, if made of gravel or broken stone. This, when compacted, interlocks, is resilient and yielding to a degree, and sustains the heaviest loads. Can it be said these roads only lack the principle of rigidity to assure their traffic-resisting qualities? We would recommend covering the surface with a granite-like unit, having a face about 3 x 9 in., to assure the lasting quality of these roads.

Slabs Made Too Rigid

What evidence has the state highway department to justify it in increasing the depth of the rigid slab? C. C. Wiley, associate in civil engineering and head of the road school, University of Illinois (see *Brick and Clay Record* of June, 1919, p. 1067) says, "the rich mixtures for concrete roads were not adopted to give the pavement load-carrying strength, but to develop sufficient wear resistance." And furthermore, "Nobody knows just how thick a pavement base should be. In fact, this is impossible to determine with our present knowledge. We can only lay a road, and if it holds up we know it is strong enough, while if it breaks we know it isn't."

The experiments worked out in the road laboratory of the University of Illinois, and the roads which have been built according to those experiments, clearly prove that the transverse strength, even of a 6-in. slab supported by the compacted earth, is sufficient to support the heaviest road traffic. The saving of excessive concrete material without reducing the efficiency of the road means the saving of money. The late W. W. Marr, Illinois state highway engineer, working in harmony with the road laboratory at the University of Illinois, reached this conclusion: That the monolithic idea of brick-road construction provided a waterproofing for the graded roadway; that the roadway itself, if kept dry, was not affected by rains or frost and of itself produced sufficient load-bearing strength to support a thinner wearing surface composed of cement-filled brick.

Following this theory of the thinner slab, he approved 174 miles of 6-in. monolithic-brick roads designed for Vermilion County, Illinois. He had previously designed a series of test roads which were built near Danville, Ill. These test sections were built under the direction of P. C. McArdle, superintending engineer of Vermilion County, and they show that a 5-in. monolithic slab (4-in. brick on 1 in. of cement mortar, and a 6-in. slab (4-in. brick on 2 in. of mortar) are equally in a perfect state of preservation after four years of heavy traffic under steel tires and trucks. These test roads were described in *Engineering Record* of Sept. 30, 1916, p. 400. They prove that money can be saved by reducing the thickness of the slab, without reducing its efficiency as a "beam" or support for the road traffic.

In his article the engineer says, "the Illinois department has assumed that, in the light of our present knowledge it is reasonable to consider the combined concrete and brick slab to be equivalent, from a flexural standpoint, to a homogeneous concrete slab having the same quality of concrete." The tests at the University of Illinois show them to be equivalent, although the mix under the brick was 1:3:5, while the mix of the concrete slab was 1:2:3.

He further says, "under this assumption a monolithic brick road may be considered in exactly the same class as a concrete road, in so far as traffic-supporting capacity is concerned." Professor Wiley, in his article above referred to, says: "As a result of our tests of the rigid types, we firmly believe that a monolithic brick road is as strong, inch for inch of thickness, as the usual concrete road. In these tests we used a bottom course of 1:3:5 concrete with the brick, and made our comparisons with concrete slabs proportioned 1:2:3, all using aggregate such as is commonly acceptable in one-course concrete roads in central Illinois. Although the averages indicate a slightly greater strength in the brick combinations, I believe it safer to consider the two types as on a par, to allow for possible variations."

The brick slab as designed by the state engineer at the letting in question, specifying a 4-in. brick (the only type of standard paving brick on the market within shipping distance of the roads in question) although admittedly equal to the concrete slab in load-distributing strength when of the same thickness, was designed thicker than the concrete slab; consequently, from the standpoint of competition, it was much more expensive. We insist this was unfair. The mix under the brick was enriched over the specifications of former years and made more expensive by the addition of cement.

Three-Inch Brick More Expensive

It is true, one type of brick construction was designed the same thickness as the concrete slabs, but a 3-in. brick was used. Based on experience, manufacturers say it is about as expensive to make a 3-in. brick for cement filler as it is a 4-in. brick. The 3-in. column of clay reduces the machine capacity 25% in tonnage. There is no established market for the off grades of 3-in. brick with a wire-cut lug for cement filler. It would have been better for everybody had he kept to the 4-in. brick and designed the base 1 in. thinner, making the two slabs the same. But he preferred to adopt as his standard a brick which is not generally made and on the market.

In further explanation of his design he says, "the problem is somewhat different if 4-in. brick are used, because, if the same total thickness (7 in. at the side) is maintained, the base would be so thin as to require a finer aggregate and more care in construction." We cannot agree with him that the finer aggregate, when used in the base of monolithic pavements, increases either the cost or the difficulty of construction. In fact, contractors assure us that the exact opposite is true.

Nor do we think it fair to place the monolithic-brick slab of the most expensive design, even if it had been designed the same thickness as the concrete slab (which it was not) in competition with the concrete slab having the cheapest grade of aggregate. In his article the engineer states, "the stone available for macadam road building in Illinois is a comparatively soft limestone, which crushes under heavy rolling." Yet this same stone is admitted by him as the aggregate in the design of the concrete road. There is a big difference in the wear-resisting qualities of the two aggregates, limestone and vitrified brick. The reports from the state highway department on maintenance of the two types of road show a vast difference, the lesser cost of maintenance being in favor of the brick roads. In Vermilion County, Illinois, that part of the Georgetown road constructed of concrete with a limestone aggregate is showing much greater signs of abrasion than the brick section of the same road. The one best principle which the monolithic brick idea injects into the concrete road is a large granite-like aggregate for the surface.

Brick Has High Tensile Strength

A comparison between a paving brick and a section of concrete of the same size, the concrete being of the ordinary road variety, the test being made at the University of Illinois, shows that the tensile strength (pounds per square inch) of concrete is 520, as compared with 1499 for brick; that the beam or breaking strength (pounds per square inch) of concrete is 490 as compared with 2700 for brick; that the crushing strength (pounds per square inch) of concrete is 4200 as compared with 12,600 for brick. A further comparative test has frequently been made by making a series of concrete blocks of equal size with paving brick and submitting them to the rattler test for abrasion. This will show a difference too great to measure.

The test I have in mind showed that the brick, after being rattled for one hour, sustained a loss of 17%, while the concrete, after being rattled 20 min., showed a loss of 70%. Such tests as these, for tensile strength, beam strength, crushing strength, and abrasion, clearly show that the presence of a hard-burned shale brick in the surface of a concrete slab gives it a better wearing surface.

And we cannot agree with the statement of the engineer in his article which says, "any of the three types of rigid pavements considered—namely, concrete, brick and bituminous concrete on a concrete base—has sufficient wear-resisting qualities to make this factor comparatively unimportant." To every observer of road construction there must appear a great difference in the wearing qualities of the surface of brick and of concrete where gravel or limestone aggregate is used. Brick as a wearing aggregate costs more, lasts longer, is worth more, and should not be compelled to compete in price with limestone and gravel.

The commissioners of Wayne County, Michigan, who are the pioneers in the construction of concrete roads on a large scale, have adopted crushed granite or traprock for the coarse aggregate of the wearing surface. It would seem the State Highway Engineer of Illinois and the commissioners of Wayne County are pursuing different courses, both of which cannot be right.

At the letting in Springfield, the contractors refused to submit a bid on brick under the circumstances, although they were urged to do so. The universal answer of the contractors was that the construction specified for the brick pavements was very technical and almost impossible, and such as to make it useless to bid on brick because of the greater expense.

By reason of over-refinements in the monolithic specifications and discrimination against the brick road of common usage, it would seem that an attempt is being made to design brick off the program in Illinois.

HARVEY C. ADAMS, President,
Illinois Clay Manufacturers' Association.

Danville, Ill.

[Mr. Adams' letter was submitted to Mr. Older, who replied as follows:—EDITOR.]

Sir—Any argument for the adoption of the so-called flexible types of road construction, such as gravel, asphaltic-macadam, brick laid on compacted gravel or broken stone, etc., for a new trunk line system of any state, with our present knowledge of what future traffic on such a system may be like, would carry great weight if it were not for the fact that common observation indicates that while such roads may serve with low maintenance cost for many years under light traffic, yet they may, and frequently are, destroyed almost over night, or become excessively expensive to maintain, when the traffic changes to motor-truck transportation. Practically every engineer who has made a study of the subject is familiar with numerous examples which have occurred during the past few years.

Several miles of exactly the same type of road as that advocated by Mr. Adams exist each way from the City of Sterling, Ill., and, while these roads were constructed on an old macadam base presumably thoroughly compacted by traffic, and have been in service but three or four years, they show in considerable stretches unmistakable depressions and ruts; and certain sections must be taken up and relaid within one or two years or be utterly unfit for the passage of ordinary traffic. Again, a contractor who is building a stretch of Federal-aid road in Illinois has been refused the use of the brick streets of a small village because of the destructive action of the trucks he is using to haul his material. Endless examples of similar character can be cited of the practical destruction of city streets in Chicago and other places.

On the other hand, monolithic brick, concrete, and asphaltic concrete on an adequate concrete base have, in the main, withstood such traffic.

Are the designs for rigid pavements adopted by the State of Illinois unnecessarily thick and therefore expensive? Possibly so; but if this is the case it is my opinion that not only are monolithic brick designs unduly strong, but also the design for the concrete pavement and for bituminous-concrete top on a concrete base. One issue of the bulletin published by the United States Bureau of Public Roads gives illustrations of monolithic-brick pavements on a 4-in. concrete base having been destroyed by Army motor-truck traffic. Likewise, the destruction of thin or lean concrete slabs is also known.

As indicated in the original paper, it was the judgment of engineers of 11 states that stronger concrete slabs should be built, and if so, why not brick slabs of equal strength? The design of concrete slab adopted by Illinois averages about ¾ in. thicker than heretofore used. The proportions of concrete are not changed, but the specifications as to the amount of mixing water, curing of the concrete and the finishing of the subgrade are much more rigid. By these provisions we believe that the strength of the concrete slab being built under the present Illinois specifications is from 50 to 75% greater than under previous specifications.

In the article by Professor Wiley, referred to by Mr. Adams, Professor Wiley makes no claim for a greater strength in the monolithic-brick slabs than the concrete slabs tested. Mr. Adams quotes Professor Wiley as saying: "Nobody knows just how thick a pavement base should be. In fact, this is impossible to determine with our present knowledge." In the next paragraph Mr. Adams says, "those experiments clearly prove that the transverse strength even of a 6-in. slab supported by the compacted earth is sufficient to support the heaviest road traffic." The two statements are hardly consistent. I presume that the engineering profession has drawn its own conclusions from the result of Professor Wiley's tests. I would call attention to the low results secured where the brick courses were transverse and the brick surface of the slab placed in tension. This condition occurs in every brick road that has a transverse joint or crack.

The concrete base adopted by Illinois where 4-in. brick are used is of exactly the same thickness as where 3-in. brick are used, but composed of leaner concrete. The base, therefore, should be cheaper. Then, if 3-in. brick are so difficult and expensive to manufacture, it is hard to explain why at a recent letting in Illinois, where bids were submitted on both types, the bids for the 3-in. monolithic brick were more than 10% under those for the 4-in. brick.

As to the comparative wear on concrete and brick roads, it is hardly to be denied that a properly constructed vitrified-brick surface will resist abrasion better than limestone concrete. That this difference in wear resistance on rural roads in Illinois is critical is questionable. Milwaukee Ave., the main road leading north from Chicago, and the Dixie Highway, south of Harvey, leading south from Chicago, carry perhaps as much traffic as any rural highways in this state. The oldest sections of these roads constructed of 1:2:3½ concrete have been down six years, and in places still show float marks made in finishing the work.

ROADS NOT DESTROYED BY ABRASION

One can only give an opinion upon such a subject, but from observation it seems clear that the trunk line roads of Illinois, whether constructed of limestone concrete or vitrified brick, will eventually be destroyed in some way other than by abrasion of the surface.

The difference in the behavior of a soft stone in a macadam road and the same stone in a concrete surface is well known and obvious. In the macadam road under heavy traffic the stones grind against each other and become crushed and rounded. In Cook County, Illinois, a limestone macadam road was utterly pulverized by heavy trucks hauling stone over it for the construction of another road. The same trucks passed over a section of concrete road which was unaffected by the traffic, although composed of limestone of the same character obtained from the same district.

In calling for bids on brick, concrete and bituminous concrete on a concrete base, there was no thought that any of these three types could compete with the other in first cost. In the opinion of the writer, it would be absurd to attempt to design brick roads or bituminous-

concrete pavements on a first-cost competition basis, unless it were obvious that each such design would have equal carrying capacity and durability, or require compensating maintenance expenditures. If it is reasonable to say, "Why not design brick roads thinner and cheaper?" then why not design concrete roads thinner and cheaper, and also other types, and continue to reduce the thickness until we have no pavement at all?

The economic problem is not one of competition in first cost, but that of least ultimate cost considering maintenance and renewal expenditures. There should also be considered the character of service rendered by each type, including comfort, appearance and delays incident to repairs.

CLIFFORD OLDER,
Chief Highway Engineer, Illinois.

Springfield, Ill.

Engineers' Education and Compensation

Sir—In Director Palmer C. Ricketts' letter in your issue of May 29, 1919, p. 1075, my one-time professor states, "but the cold fact remains that services in the long run receive the payment they are worth."

I would ask his attention to the following, which appeared in the Searchlight section of one of your recent issues:

> Civil engineer or mechanical engineer, wanted by consulting engineer to take charge of branch office in Eastern United States. Salary $150 to $200 a month. Man who has had experience in factory design and construction preferred.

Even back in 1912 would my esteemed professor have considered the recompense offered commensurate "payment" or are the years of experience necessary to be able to assume the responsibilities of the *managership* in question worth no more? With such prospects ahead, would he believe one inclined to tell any young fellow to follow as I did the advice given me to beg, borrow or steal the funds needed to finish my course, when it takes six to seven years after completion to return the money, and then, with what funds were laid by, to strike out for himself if one were so inclined?

Brooklyn, N. Y. ADOLF HINRICHS.

Activities of "Engineers' Union, Local No. 1," Visualized by Correspondent

Sir—The amount of space you have been giving in your correspondence columns to the subject of engineers' salaries leads me to believe that you may be interested in the following account of the organization of the Engineers' Union, Local No. 1.

From levelmen and draftsmen to chief engineers, they have organized in New York. The long awaited amalgamation of American brain workers with American hand workers has begun. A group of intellectuals who have clung tenaciously to their professional status have voluntarily surrendered their professional pride to place themselves under the protective guidance of the "hand workers."

The engineers of New York were not especially moved by the emotional tides that run in the heart of the world. They were not responding to revolutionary ideas caught out of the surcharged air. They had simply grown tired of wearing their white collars longer than they liked, eating poorer meals than agreed with them three times a day, moving their pinched families further and further out into the low-rent suburbs, thinking perpetually of having to quit the "game" that fascinated them, enduring what wage-workers are understood to have endured in the past. Their union is a product of simple economic pressure guided by herd instinct.

Last August, when New York engineers' "salaries" averaged $28 a week, the men, despairing of getting more money by individual pleading with their employers, called an organization meeting. A fair proportion of New York's hundreds of engineers came. An old-fashioned trade-union organizer addressed them as "brainless brain-workers." The words marked no new literary epoch in New York; but next day—pay day for one of the biggest companies—for the first time in years the pay envelopes were not ready. When they finally appeared, each envelope contained from $3 to $7 more than usual. Honest engineers questioned the management, but could get no explanation except the assurance that the amounts were not clerical errors and that the apparent mistakes were likely to be repeated next week.

Other companies developed the same mysterious habit. Did the Galileos of our American Rome sit back content in their ability to smoke cork tips instead of plain ones? Oddly enough, these brain-workers reacted just as certain other cultured, farsighted men, miners, hod-carriers, teamsters and plumbers, reacted some generations ago. "If," they soliloquized, "we got that from one meeting without making demands, what shall we get if we organize and demand?"

There had been an engineering organization in New York for years; but it was of the kind that didn't debase itself with consideration of wages, least of all with strikes. It was a salaried professional men's club, dedicated to the good-fellowship of smokers and banquets and to the flower fund for funerals, and to the reading of "papers." It was not such an association as would have dreamed of calling in an old-fashioned organizer from the ranks of the hand-workers for counsel. But it was done now, and the hand-workers showed them how to organize a real union. The new union grew. New York companies employing engineers had seizures every few months of that curious trembling which shook $3 to $7 more into the pay envelopes. Last spring the union presented demands—a $60 minimum for men in supervisory or equivalent positions, and $45 for those in subordinate positions.

How did the brain-workers arrive at those figures? Did they have statisticians make elaborate investigations of the cost of living for professional men and compare figures with an estimate of the social worth of engineers in the community, or indicate the ratio between the level of thought in New York and the state of the creative instincts in the engineering profession? Nothing of the sort. They simply asked the other union men on the job, the trench-diggers, carpenters, masons, ironworkers and such "rough-necks," what they were getting. These base mechanics, they knew, had been reopening their signed two-year contracts every few months and had been getting raise after raise, until they were getting what, to the brain-workers, seemed very handsome pay. The union designers and superintendents, in a stir of their old professional pride, decided that wages for originating and supervising the designs ought to be bigger than for merely carrying them out. The ironworkers' union, by which they were chartered, agreed to indulge their

vanity. So they tacked a few dollars onto the field riveters' scale—and demanded.

They ran slap into the same old problem which heroic pioneers, like the gasfitters and unbasted children's garment makers have always encountered, recognition of the union. And, like the miners and railroad men and glass-bottle blowers of old, the office men and field men had to establish in conference what was legally involved in their asserted right to collective bargaining. Their employers, like plumbing contractors before them, declared that to recognize the union meant handing over their control, meant "dictation of the business policy by employees," etc. Legalistic argument monopolized the conferences. There was a rumor that all the employers of engineers in America had their eyes on New York, hoping for a massacre. The organizers of the new union got strike sanction from the parent ironworkers' union, and the engineers began asking what the mighty "hand" unions could do to help the infant "brain" union in case of strike.

The engineers set an hour for a union meeting, to be attended by all members at all costs. The hour was in the middle of the work-day. The "hand" unions set the same day for a chapel meeting; the hour was a little past the middle of the work-day. Nobody said so, but the suspicion spread that the engineers might vote to strike, and that the mechanical unions, though bound by contracts not to strike, might find so much ordinary business to transact in chapel that field work would have to wait for days or weeks for chapel to adjourn. The employers decided that legal contention would waste money and provoke needless bad feeling. They withdrew their attorneys and settled.

In their first meeting after their victory the Engineers' Union, Local No. 1, did not spend its time discussing the relative efficiencies from the point of view of initial and maintenance costs, and the probable percentage of error, of the ice-bar and the duplex bar, nor was a paper read on the rainfall records in Iceland for the past 90 years. They discussed instead whether hours and working conditions weren't after all the next legitimate business of their union. They did not ask a committee to draw up an ideal curriculum for an engineering school, which should include more English and other cultural subjects, so that the graduates from the engineering schools might be more broadly gaged and educated men for the $125-$150 jobs they would fill if they were lucky. They debated instead what to do about the Public Service Commission's layoff of nearly 400 engineers. They noted that the railroad technical men had been granted an increase in salary; but they did not agitate and pass resolutions for the establishment of an utterly useless, aristocratic Engineering Academy for the gratification of the personal vanity of some of the exploiters of engineers' services.

You don't believe all this, do you? You're right, it *is* too good to be true. Such a union has not been formed; the meetings described were never held. The recital is a slightly modified account of the organization, not of engineers, but of reporters and editors in Boston, taken from the latest issue of the *New Republic*. Engineers have sharp intellects, are logical and accurate reasoners, accomplish wonderful things in the realm of applied science. But when you have said that, you have said all that you can say for them. When it comes to bettering the conditions of their profession—not, Heaven forbid, raising them to the level of those in the masons' or carpenters' trades, but just enough to place engineers merely at the level of stenographers—then all the acuteness of their minds, all the inexorableness of their logic, all their cool and analytical thought, doesn't seem to do them any good. And they let themselves—and what is worse, they let young boys who might be saved from what is in store for them if they begin the study of engineering—be fed with such stuff as, "A graduate in engineering is self-supporting from the time he graduates," by one professor; and, "I have never been out of a job in all the 23 years that I have been practicing," by a well-known secretary of one of the founder societies; and "Engineering services are being paid what they are worth," by the head of an engineering school, and similarly accurate statements by men of the same class, who have axes of their own to grind by making it appear that the profession is not what it really is, and who are so completely out of touch with the real conditions in the profession that their misleading and false statements, calculated to be impressive because of the prestige that attaches to their positions, are little short of criminal.

Newark, N. J. HARRY BERLIN.

As Others See Us

Sir—I heard something about engineers the other day from a great man—an acknowledged statesman, a high-minded politician, and a keen observer of people and events. His name, if I were permitted to tell it, would surprise every reader of this message. We were talking about our project for a National Department of Public Works. I am able to quote the statement almost verbatim, because the words burned in as they were uttered.

> Your task is appalling. You have been elected to lead engineers into a political reform. They are the most unresponsive citizens that we have. Your organization has a praiseworthy purpose, but if it were sponsored by almost any other group of reputable men than engineers there would be more promise of success. If your organization succeeds I believe you will find that it will not be the engineers who have carried through. Their aloofness and indifference to all matters outside of their own professional sphere are among the unexplainable things in our political life.

That statement hurt. How many other public men have the same opinion? As it comes from a high authority, who is not given to loose talk, it seems wise to pass it on.

M. O. LEIGHTON,
Chairman Engineers, Architects and Constructors' Conference on National Public Works.
Washington, D. C.

Salary Diagrams in College Catalogs

Sir—Apropos of the recent discussion in your columns on the compensation of engineers, between Mr. Ricketts and others, would it not shed light on the situation if the colleges prepared and published salary diagrams of their graduates, similar to those prepared a few years ago by the Am. Soc. C. E. Committee on the Compensation of Engineers? [See *Engineering News* of Jan. 4, 1917, p. 40.] Such a diagram, kept up to date and published each year in the college catalog, would be eminently fair and honest to prospective students, by giving them an idea of what they might expect in the line of work they were thinking of following.

Fort Shaw, Mont. GEORGE HENRY ELLIS.

Commends Tests for Shear Values of Timber Beams

Sir—The tests on shear values for yellow-pine beams by L. R. Manville and C. R. Hill in your issue of July 10, 1919, p. 69, are timely, and the writer believes the conclusions to be well taken.

The prevalent limiting values of safe unit horizontal shearing stresses for very short timber beams, or for timber beams with a heavy concentration near the support, have been annoying to the writer's sense of proper proportion for many years. Undoubtedly, other engineers have experienced the same difficulty in making the calculated size of a short timber beam subjected to a concentrated load, when designed with a maximum unit horizontal shearing stress of around 150 lb., conform to one's common-sense judgment of the necessary size. Such problems occur frequently, as in the case of a timber grillage, concentrated loads near the support of girders, etc.

The writer wishes to thank Messrs. Manville and Hill for making available the results of these interesting tests. HENRY D. DEWELL.

San Francisco, Calif.

Simple Method for Finding Section Modulus of I-Beams

Sir—Referring to the article entitled "Easily Memorized Method for Finding Safe Beam Loads," by Manton E. Hibbs, in your issue of July 17, 1919, p. 115: Another very simple way of arriving at the approximate section modulus of I-beams is to multiply the depth in inches by the weight per foot, and shift the decimal point one place to the left.

Thus, for a 9-in. 21-lb. I-beam, the section modulus would be found to be $9 \times 21 \div 10 = 18.9$. This method is easier than that suggested by Mr. Hibbs for depths of 6 to 10 in., inclusive. It is slightly less accurate than his method for depths of 12 in. and above. G. S. BURRELL.

New London, Conn.

Sir—The writer read with much interest Mr. Hibbs' method for finding safe beam loads, in your issue of July 17, 1919, p. 115, but believes that he has used a simpler method which requires no memorizing other than the ordinary knowledge of the size of beams and channels. This method is the following:

A beam or channel will support as many thousand pounds uniformly distributed for a span equal in length in feet to its depth in inches as its weight per foot in pounds. The load for any other span length is inversely proportional to the span.

For example, a 12-in. x 31½-lb. I-beam for a 12-ft. span would support $31\frac{1}{2} \times 1000$ lb., or 31,500 lb.; this is very close to 31,970 lb., the correct load as given in the tables. Or a 6-in. x 12.25-lb. I-beam for a 6-ft. span would support $12\frac{1}{4} \times 1000$ lb., or 12,250 lb., quite close to 12,910 lb., the correct load as given in the tables.

By comparing the safe uniform distributed loads obtained in this manner with those shown in handbooks it will be found that the method given above is sufficiently accurate for ordinary purposes.

Portland, Ore. W. H. CULLERS.

Engineering Specifications and Responsibility

Sir—Recently there was brought to my attention a specification which definitely fixed the method by which drain tile should be laid, and defined the device to be employed. Upon careful inquiry, I discovered the device was a patented fad of the engineer drafting the specifications. Now, we all will agree that such procedure, if required for personal gain, was improper, but on the other hand, if this engineer had discovered in practice a method that would insure a satisfactory installation of drains to allow the inflow of seepage water and that would exclude the quicksand, thus insuring a permanent structure, was he not justified in recommending this device and enforcing its use if necessary?

On the other side of this question, I had the opportunity of reviewing a specification which plainly stated that the contractor was free to employ any device and to use his own judgment in the matter of installing the drains, but that the commissioners of the drainage district would hold him responsible for a permanent and satisfactory structure. The engineer drafting the last-mentioned specification had explained to the board of commissioners that under an opinion handed down by the Supreme Court of the United States recovery could not be made against a surety company or the contractor if methods were required by the engineer and complied with by the contractor, and such methods were found to be the cause of failure.

We must all agree that the engineers' responsibilities diminish as the contractors' responsibilities are amplified, and should the contractors finally realize the importance of having superintendents and foremen with some engineering experience and ability, and should they discard the "mule drivers" and "man killers," they would soon render the engineer and inspector a useless ornament on works of importance.

In conclusion, there are two great changes necessary in this important branch; the first is for students of engineering to acquire the additional knowledge necessary to equip them for the general management of construction works, and the second is the necessity for the contractor to realize that the standard of success is not measured by the dollars made, but by the success of the structures built. W. P. BULLOCK.

Kansas City, Mo.

Economic Side of Engineering Profession

Sir—It is to be hoped that the *Engineering News-Record* discussions of the economic side of engineering will lead to something more definite than a mere reiteration of the fact that all is not well with the profession. The point has been reached where all must admit the need of drastic action to quiet the growing unrest among technical engineers.

The immediate need is for a readjustment of the salaries of employed engineers. This part of the problem has been undertaken and will be pushed to a successful conclusion by the American Association of Engineers.

This is only a good beginning. The predicament in which we find ourselves is partly due to the fact that young men in ever-increasing numbers are attracted to engineering by the promises of large salaries, held out to them by the technical schools and colleges, as well

as by the correspondence schools and those so-called schools which attempt to turn out engineers and draftsmen by means of a few months of home study. The resulting oversupply of trained and half-trained engineers keeps wages down and makes it difficult for the engineer, particularly the young engineer, to keep continuously employed even at a low salary.

The proof of that statement is the system followed by many employers of engineers who "hire and fire" according to the slightest fluctuation of their need. The attempt to hold the young engineer over a dull period is reduced to almost nothing, because the employer can obtain unlimited engineer assistants at his own price and on short notice, due to this oversupply.

Moreover, another effect is beginning to be noticed. As the men new in the profession become disillusionized, some of the best of them begin to look toward other fields of endeavor for a living. If this tendency is allowed to increase, only two classes will continue in engineering—the idealists who are determined to stick to their chosen profession at whatever sacrifice, and the poorer grade of men who lack initiative and are content with any work as it offers a bare existence. Unfortunately, there are but a few of the first class compared with the second, which is only too numerous.

In spite of these things and others which might be mentioned, all tending to make the life of the technical engineer anything but enviable, there are movements on foot—one, at least, national in scope—to increase still further the supply of young engineers. The effort apparently has the support of many of the large technical educational centers, notwithstanding the fact that a part of the plan consists of an attempt to introduce a smattering of engineering theory into general business courses, with the notion of turning out, in this way, engineer executives. The result will inevitably be a still further cheapening of engineers and their work.

It is a generally accepted truth that one who offers adverse criticism of a condition or course of procedure should be ready with a remedy or substitute for the thing criticized. The simple way to get at this matter of oversupply is for professional engineers, through their associations and societies, to tell the exact truth.

This would offset the rather highly colored inducements offered by so many of the schools and colleges. Let the emphasis be put on the actual experience of the majority of technical men who work for a pittance under high-sounding titles, rather than on that of the few who really are successful materially and otherwise. Closely allied with this move should be the effort to pass proper license laws. Such procedure will cut the supply, it is true, instead of increasing it, and that will be regarded as heresy by many.

Cleveland, Ohio. ERNEST R. TAYLOR.

Fatigue Tests of Alloy Steels and Conclusions Therefrom

Sir—In your issue of July 10, 1919, appears a summary of a paper entitled "Some Fatigue Tests of Nickel Steel and Chrome-Nickel Steel," presented by the undersigned before the American Society for Testing Materials. In that summary it is stated that the authors drew certain conclusions quite different from the conclusions which they intended.

The *News-Record* summary states that the conclusion is drawn that "nickel steel has higher endurance qualities" than chrome-nickel steel. Again, it states that the authors drew the conclusion that "hardening and tempering do not improve the fatigue-resisting qualities of the metal, but rather have the opposite effect." The original paper states:

In connection with the above paragraphs these test results should not, of course, be interpreted to mean that chrome-nickel steel is, in general, inferior in fatigue resistance to nickel steel. These tests give values for the two lots of steel tested, and it should be remembered that the original bar of chrome-nickel steel was worked down to a small size under a forge shop hammer. Injury to the structure of the material may have been done in that process.

The tests also indicate that a given heat treatment may give high elastic static strength to steel without proportionately increasing its resistance to fatigue under repeated stress. This is shown by the convergence of the graphs for heat-treated steel and for annealed steel shown in Figs. 3, 4, and 5. Here again a warning should be sounded against drawing from these tests the general conclusion that all heat treatment is ineffective in increasing the resistance of a material to fatigue under repeated stress. The test results apply only to the particular conditions of heat treatment actually given to the specimens tested, but they do furnish an illustration of heat treatment which raised static elastic strength without proportionately increasing resistance to fatigue under reversals of low stresses.

It is further stated in the *News-Record* summary: "Both these conclusions, however, are made entirely on the hypothesis of the experimental (exponential?) law connecting stress and number of repetitions or alternations required for failure; in other words, the law under which the logarithmic plot of repetitions and stress would be a straight line. The logarithmic plotting method is used as the basis for all the conclusions drawn, although the experimental points are scattered on both sides of the arbitrarily drawn lines."

This statement is not correct. The original paper gave tables of results and graphs both with logarithmic coördinates and with ordinary coördinates. The figure given in the *News-Record* summary as "typical" is not typical, because it gives only the logarithmic diagram, omitting the diagram with ordinary coördinates, which in the original paper was placed beside the logarithmic diagram.

The whole point of the paper was to show that the fatigue-resisting strength of a metal for a large number of repetitions of low stress could not be determined either by determining the static "elastic limit" of the metal, nor by short-time, high-stress tests under repeated stress. For any two metals the ratios of the elastic limits, of the resistances to fatigue under high stress, and of the resistances to fatigue under low stress, may be three different quantities. This conclusion may be drawn either from the tabular values given in the original paper, from the graphs plotted with ordinary coördinates, or from the logarithmic diagrams. It is not dependent upon logarithmic plotting.

In this connection it should be noted that in the diagram given in the *News-Record* summary there has been inserted a plotted point for the heat-treated nickel steel which is shown very remote from the diagram, and which is not in the diagram of the original paper, and for which there are no corresponding values in the tables of data given in the original paper. This "wild" point throws no small discredit on the accuracy of the diagram, and is evidently a typographical error.

Urbana, Ill. H. F. MOORE,
ARTHUR G. GEHRIG,
University of Illinois.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

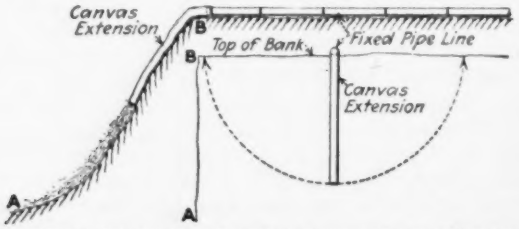
Keeping Scrap Cleaned Up Saves Money

BY ALBERT S. FRY
Morgan Engineering Co., Memphis, Tenn.

SALVAGE of all discarded materials, says J. W. Radford, makes workmen more careful of machinery and economical of repair parts. Mr. Radford, who is superintending the construction of about 5,000,000 cu.yd. of levees by walking draglines in the Inter-River Drainage District in Missouri, believes that it is economy for the contractor to keep scraps of iron, such as broken machinery parts, cleaned up and disposed of, and not to allow these to be thrown away along the right-of-way of the work. It is his opinion that a failure to salvage broken parts tends to carelessness, on the part of the workmen, with machinery and repair parts. It is not uncommon to walk along work where a dragline or dredge has passed and find broken parts left to rust. A wornout bucket discarded on top of a spoil bank is not an unusual sight. Mr. Radford thinks it is better to collect this scrap-iron and haul it where it may be sold or otherwise disposed of, even though doing so apparently costs more than to throw it away. A teamster can do this work at odd times, when he would be doing little work of any sort, and thus it really costs very little. The profit comes in the spirit which is instilled into the employees who go about their work with more care and appreciation of the value of the machines they are operating.

Canvas Pipe Gives Flexible Distribution of Sluicing Water

A CANVAS extension to the steel or wood-stave pipe line permits more flexible distribution of the sluicing water in hydraulic filling operations for the Taylorsville dam of the Miami River flood-protection works in Ohio. At Taylorsville a bank, A-B, is being cut down by hydraulic giants, and the material sluiced to centrifugal pumps which discharge through a pipe line to the dam embarkment. The water needed to float the excavated material to the pump comes by pipe line to the top of the bank. Here a 50-ft. canvas tube extension is attached to the end of the fixed pipe line and laid down the bank to discharge where the water is wanted. By swinging the canvas tube to the right and left, water can be delivered at any point of a considerable area of the bank face, without shifting the main pipe line. The diagram indicates the arrangement. Arthur E. Morgan is chief engineer, Charles H. Paul is assistant chief engineer, and C. H. Locher is construction manager of the Miami Conservancy District flood-control operations.



DISCHARGE OF SLUICE PIPE SHIFTED BY CANVAS EXTENSION

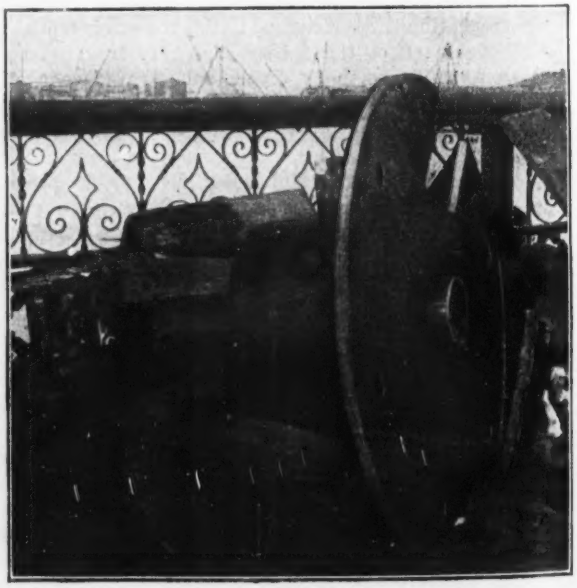
Other Articles in This Issue of Interest to Contractors:

Construction Details of the Lindsay-Strathmore Irrigation District — Page 348
Block Yard Cheaply Improvised From Old Equipment — Page 356
Telescopic Foundation Caissons Sunk in Bank Basement — Page 369
Hydraulicking Dam Embankment on Miami Flood-Control Project — Page 371
Illinois Brick Paving Specifications (Letter) — Page 383

Cutting Granite with Oxyacetylene Flame

DURING the repairs on a 1900-ton drawbridge, located where the Lincoln Highway crosses the Passaic River near Newark, N. J., it was found necessary to remove the center casting and pin, the latter being so tightly wedged that it was impossible to pull it from the casting which, with other damaged parts, is shown in the photograph. A description of the damaged portions of this bridge was published in *Engineering News-Record* of April 18, 1918, p. 775, and the details of repairs are described in this issue, p. 366.

After several unsuccessful attempts to draw the pin from the casting below which it projected down 3 in.



CASTING AND OTHER DAMAGED PARTS OF BRIDGE

into the masonry, it was found necessary to cut a trench in the hard granite so that the casting might be shifted laterally to one side for removal and replacement by a new and larger center casting. This trench was 4 ft. long, 9 in. wide and 3 in. deep, extending under the old casting.

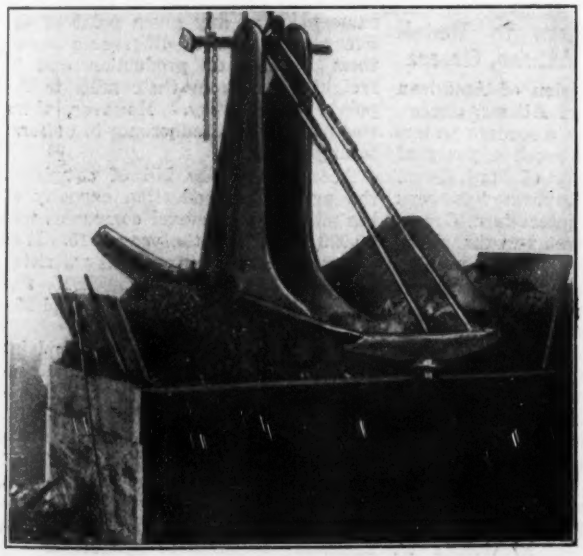
The cutting of the trench would have been an endless task had it not been discovered that an oxyacetylene flame chipped the granite quite readily and could be used under the old casting without damaging the balance of the masonry. The desired channel was thus quickly obtained. The flame was also used for cutting away the abutment back of the fixed span bottom chord to provide expansion clearance. This work was under the supervision of T. J. Wasser, county engineer of Hudson County, N. J., and was done by the Bethlehem Steel Bridge Corporation, with Thomas D. Fulton as erection engineer.

Repairing Orange-Peel Dredge Buckets Without Costly Delays

By J. C. Lamon
Alcoa, Tenn.

ORANGE-PEEL dredge buckets were repaired upon a job in Tennessee without the costly delays incident to shipping them to a foundry. This was done by simple blacksmiths' methods. The buckets had been damaged by lifting heavy stone on the Little Tennessee River hydro-electric development of the Knoxville Power Co., near Alcoa.

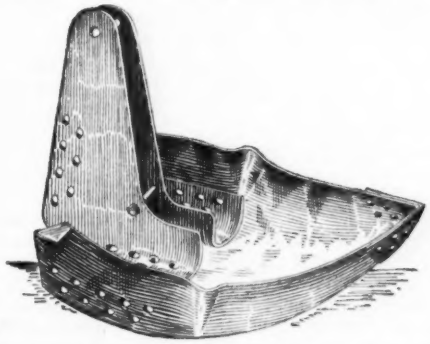
Lifting heavy stones had badly straightened the sectors, by overloading, the six-ton buckets being damaged the worst and becoming practically worthless for dredging purposes in the river. These distortions were corrected and the buckets were placed back in service practically as good as new. The methods followed in re-forming the sectors are shown in the accompanying illustrations. They were taken to the blacksmith shop, where they were dismantled, a special forge and blast pipe being constructed to accommodate the blades.



HEATING ORANGE-PEEL BUCKETS, NOTE ADJUSTMENT OF TURN-BUCKLES AND FORGE CONSTRUCTION

Heavy turnbuckles and rods were adjusted as shown, and the sectors were heated and pulled back to the proper radius by means of the turnbuckles.

By referring to the photograph, the arrangement can be noted, also the construction of the forge. A very narrow car was used with a heavy bed of hard coke, the fire being prepared as though heavy forging was to be done. The blades were heated evenly across the entire width, except the edges. Beginning with the



BUCKET BLADES WERE DEFORMED IF EDGES WERE HEATED

first heat at the base of the arm, the turnbuckles were tightened, until the correct radius was obtained at that point. They were then moved back out of the fire a short distance and another short heat was given, the turnbuckles being tightened as before. This operation was repeated until the correct shape of blade was obtained.

Difficulty was encountered from the fact that the blades would buckle at the outer edges when strain was put on by the turnbuckles. However, it was discovered that by keeping this part of the outer edges cool the natural shape of the bucket was retained. The sketch shows what happened to the bucket when the egdes were not kept cool.

Moisture Content of Dry Lumber

Variations in atmospheric humidity, and the greater capacity of air for moisture at higher temperature, cause marked variation in the moisture content of wood, leading to shrinking and swelling, with the well known disturbing influences of this action. The Forest Products Laboratory recommends that wooden articles be shaped and framed when their moisture content corresponds to that which will prevail in the average atmospheric state during their life, and to aid in determining this moisture content gives the table reproduced here:

When Relative Humidity of Air Is	The Moisture Content of "Dry" Wood Is— At Temperature of 70° F.	At Temperature of 140° F.	At Temperature of 212° F.
%	%	%	%
20	4.5	3.3	2.2
30	6.0	4.5	2.9
40	7.7	5.9	3.9
50	9.3	7.1	4.9
60	11.2	8.8	6.2
70	13.5	10.7	8.0
80	17.0	14.0	10.5
90	22.2	18.2	14.0
100	32.0	26.2	21.0

NEWS OF THE WEEK

New York, August 21, 1919

Would Build Public Works With Big Army Service Corps

A "Public Service Corps" of not less than 175,000 men, to be organized under Army regulations and trained and equipped to construct roads, levees, bridges or other public works, is provided for in a bill (H. R. No. 7777) introduced in Congress by Mr. Hulings. The corps would be organized on military lines, one battalion of four companies being selected in each Congressional district. It is proposed "to select the prescribed number of men by lot from amongst all of the unmarried men, citizens of the United States, residing in said district, who are between the ages of 18 and 21 years and who are physically capable of military service." The pay monthly for privates and noncommissioned officers would be as follows: Private, $50; corporal, $55; sergeant, $60; first sergeant, $65; sergeant major, $70. Commissioned officers would receive the pay of like grades in the infantry.

The Secretary of War, with the President's approval, is empowered, by the terms of the bill, to designate the work upon which the corps shall be employed and to enter into engagements with state authorities for the building of roads and other public works. The bill carries a $200,000,000 appropriation. The purpose of the bill is "to provide actual military training for the term of one year for an annual levy of the prescribed number of men and to employ the corps in building public roads." The corps would not be liable for military service beyond the boundaries of the United States.

Relief Sought for Unpaid Contractors on Government Work

To contractors on Government camp construction who were left without the hope of reimbursement for work already done, to say nothing of the right to complete their contracts, through a strict interpretation of the Army appropriation act by the Comptroller of the Treasury, relief is offered in a resolution recently introduced by Congressman MacKenzie, of Illinois. The resolution has already passed the House.

This resolution, which is in reality an enabling act, declares that Congress never intended to prevent payment for work and materials furnished under contract, although this was the interpretation put upon the bill by the Comptroller of the Treasury. The resolution covers all contracts for construction entered into by the War Department up to July 11, 1919.

Secretary Baker in a letter to the Committee on Military Affairs regarding the measure asserts that it is not the intent of the War Department to obtain authority to undertake new construction work in any Army camp, nor even to complete unfinished construction, but only to effect a settlement of obligations already incurred.

Employment Bureaus

Engineering Societies' Employment Bureau of the four founder societies, conducted by Engineering Council Employment service, for members and for other professional men introduced by members. Especial attention for those released from Government service. Address, 29 W. 39th St., New York City.

American Association of Engineers, 29 S. La Salle St., Chicago. Service to members only, but Army or Navy Engineers in uniform who are eligible to certified membership may join without payment of entrance fees or dues while in uniform and for six months after discharge.

Engineers' Service Bureau, 57 Post St., San Francisco. Only applications by mail or wire will be considered.

Professional and Special Section, United States Employment Service, 469 Fifth Ave., New York City.

Reëmployment Committee of New York City for Soldiers, Sailors and Marines, 505 Pearl St.

American Engineers to Install Water-Works at Athens, Greece

Under the supervision of American engineers, the City of Athens, Greece, is to be provided with a modern water-works system. Last week a party of engineers from the firm of Ford, Bacon & Davis, New York City, who have been retained by banking interests in Greece to investigate the water-works situation, draw up the plans for the project, and supervise construction, sailed for Europe.

The party was headed by William E. Swift, of the Ford, Bacon & Davis organization, and formerly division engineer of the Hudson River Division of New York's Catskill Aqueduct, with headquarters at Cornwall-on-Hudson.

The project for a new water-supply for Athens has been under consideration for many years, according to a statement made to a representative of *Engineering News-Record* by George W. Bacon, just returned from abroad.

Action Is Begun Against Cement Companies

Complaint Alleges Combination in Restraint of Trade and Output Reduction, To Raise Prices

Nineteen of the leading American cement manufacturers are named as defendants in an action in equity instituted last week by Attorney General Palmer, acting through United States Attorney Joseph L. Bodine, of the District of New Jersey. The complaint charges the company with engaging in a combination and conspiracy in restraint of interstate trade, with restricting production of cement, with selling at uniform "delivered prices," and with more than doubling the prices received, exclusive of freight, thus contributing to the prevailing high cost of living.

The 19 cement companies named comprise the Atlas, Allentown, Alpha, Bath, Coplay, Dexter, Edison, Giant, Glens Falls, Hercules, Knickerbocker, Lawrence, Lehigh, Nazareth, Penn-Allen, Pennsylvania, Phoenix, Security and Vulcanite.

The complaint alleges that from 1905 to 1911 the defendant corporations were organized as members of the Association of Licensed Cement Manufacturers, and were required to sell portland cement at certain scheduled "delivered prices," with freight paid, which were uniform for any given point of delivery. Following a decision of the Court of Appeals in 1912, the association was abandoned, but the companies, it is stated, continued to consider it regular for all to make the same price at any given point of delivery, regardless of differences among them in cost of production and in freight rates from their mills to the points of delivery. However, there was no consistent adherence to uniform selling prices.

According to the bill of complaint, the aggregate production capacity of the mills of the several companies was 50,000,000 bbl. in the year 1915. It is charged that the output was restricted to about 30,000,000 bbl. in 1915, 29,000,000 bbl. in 1916 and 1917, and 23,000,000 bbl. in 1918.

In 1915 the defendants, the complaint states, created an unincorporated association, with offices, first in Philadelphia and now in New York, in charge of a salaried manager, clerical assistants, and traveling and investigating engineers. The association manager, the complaint states, received full information from the various companies regarding amounts of production and contracts for future delivery, compiled

such data, and distributed them to the members of the association. It is charged in the complaint that the object of these activities was the "restriction of the amount of cement produced, reduction in the amount of cement subject to future delivery at former prices, uniformity of prices for any given point of delivery and increases of such prices."

It is pointed out that the "mill price" of portland cement has been successively increased from about 65c. per barrel in 1915 to about $1.85 per barrel at the present time.

The defendant companies, as yet, have not filed their answer to the bill of complaint.

Bill Proposed To End Housing Corporation

Dissolution of the United States Housing Corporation is proposed in a bill recently reported in the House of Representatives. Its abolishment is advocated on the ground that it was created as a war-time measure, and Chairman Langley, of the Public Buildings Committee, finds ample justification for its abolishment.

Although the United States Housing Corporation is considered a temporary organization, Chairman Langley asserts that it is being perfected on a permanent basis, that personnel is even now being augmented, and that salaries have been unnecessarily advanced.

Should the Housing Corporation be dissolved, the buildings that have been constructed by it, and which are now under its jurisdiction, would be sold by the Secretary of the Treasury under the terms of the present bill.

Another bill has been drafted providing for a Bureau of Housing and Living Conditions, in the Department of Labor. The proposed bureau would aid the Housing Corporation to bring its work to completion, and then would take over all the plans, data and reports of the corporation, as well as those of the Housing and Transportation Division of the Emergency Fleet Corporation.

Thirty Ships Delivered by Fleet Corporation in Week

If the same speed with which vessels were turned over to the Shipping Board by the Emergency Fleet Corporation is maintained throughout the month as obtained for the week which ended Aug. 9, 1919, a new record in shipbuilding may be attained. Thirty vessels were delivered during that week, adding 97,550 gross tons to American shipping.

The total gross tonnage that has been delivered to date is 4,542,278, the total number of vessels being 1227. Sixteen of the 30 vessels are contract steel, 12 are wooden and two vessels are composite.

The record is 124 vessels, delivered in July, 1918.

Protest Against Plumb Plan Continues at Hearing

Warfield Plan Urged Before House Committee—Need for Future Government Aid

Continued protests against the Plumb plan for nationalizing the railroad system of the United States have, in the past week, marked the hearings now under way before the Interstate Commerce Committee of the House of Representatives, in Washington. The Warfield plan, advocated by the National Association of Owners of Railroad Securities, was put forward by witnesses at several of the sessions as being the most reasonable cure for the threatened railroad troubles. While protesting against the nationalization of the railroad system, it was, nevertheless, the view that Congress must give constructive relief to the situation for the present, to prevent plunging the railroads into bankruptcy.

Luther M. Walter, general counsel for the National Association of Owners of Railroad Securities, said of the Plumb plan:

"It is impossible and not in line with our interests and would not profit anybody. It may be used as a shibboleth; but I think that when it is examined and understood no one will support it."

Warfield Plan Advocated

Mr. Walter pointed out that a fundamental of the Warfield plan is that labor should participate in the earnings of the carriers and that division of excess profits over and above 6% should be made among the public, the employees and the owners of the property. He strongly urged the Warfield plan.

"The keystone of the Warfield plan," said Mr. Walter, "is a Congressional direction to the Interstate Commerce Commission that it shall make freight and passenger rates sufficient to pay operating expenses, maintain railroad properties, and give not less than 6% return upon the aggregate value of the property devoted to transportation in each of the principal traffic territories."

Samuel H. Veatch, president of the Savings Banks Association of New York State, testified on the following day that millions of American investors in banks, trust companies and other institutions which put their funds into railroad stocks are directly interested in the return of the railroads to private ownership on a basis that will afford adequate protection to security holders.

Forney Johnston, advisory counsel for the National Association of Owners of Railway Securities, while urging the Warfield plan, maintained that Congress must aid the railroads, at least for the present, else bankruptcy or Government ownership would be inevitable.

At the same time the campaign to prevent the return of railroads to private ownership was resumed Aug. 18, when Representative Huddleston introduced a resolution for the appointment of a committee of six members to investigate charges of corruption by financial interests, made by the four railroad brotherhoods and other labor organizations, when the Plumb plan was put forward prominently.

Forest Service Highway Work Handicapped

Work in carrying out the 270 projects in road maintenance and construction by the Forest Service of the Department of Agriculture has been somewhat handicapped because of the nonreceipt of materials and equipment from the War Department. They had been previously expected, according to representatives of the Forest Service.

About six months ago, after an act of Congress had provided for the turning over of surplus equipment, suitable for roadbuilding, by the War Department to the Department of Agriculture, the Forest Service petitioned the War Department for a number of motor trucks, cars and road machinery. Later revised petitions were sent in which included a request for 20,000 ft. of steel cable, a number of concrete mixers and about 250 sets of double harness.

It has been reported this week that all the Forest Service has received from the surplus material of the War Department to date is 32 Ford passenger cars and several million pounds of trinitrotoluol. After the passenger cars had been delivered to the various districts of the Forest Service, it was asserted, they could not be used as passenger cars because of a law passed by Congress declaring that no money shall be expended for the maintenance, equipment or repair of any passenger motor vehicle, unless specifically provided by law.

It is maintained that the Forest Service can use on its highway projects some road drags, drilling machines, forges, corrugated iron, tents, and numerous other articles now being declared surplus by the War Department.

It is stated that delay in turning over usable equipment to the Department of Agriculture has been a serious handicap in the far Western states where road construction work in the mountains can be carried on only during the summer months.

French Housing Contract Awarded to New York Firm

As a first step in the reconstruction of the devastated areas, the French Government has let a contract to the MacArthur Bros Co., engineers and contractors, New York City, for the erection of 2000 frame dwellings. It is expected that other contracts will soon be awarded for similar construction, according to officials of the company.

The houses will be frame structure, small, and all materials, both lumber and hardware, will be shipped to

France from the United States. It is quite probable, says A. H. Baer, of the company, that the houses will be demountable and will be shipped ready for immediate erection.

A. S. Dorsey, one of the engineers associated with the Paris office of the MacArthur Bros. Co. is expected from France daily, and he will be able to furnish data upon receipt of which his company can start immediate construction. Mr. Dorsey has been in France since February, studying possible engineering development, with the French Government.

United Engineering Society Pays Tribute to Carnegie

The committee appointed by the meeting of representatives of the four founder engineering societies Aug. 11, upon the death of Andrew Carnegie, has framed the following resolution to be spread upon the records and transmitted to members of the Carnegie family:

Andrew Carnegie's death on Aug. 11, 1919, at Lenox, Mass., brought to its close a career which greatly advanced all the engineering arts and sciences. By the introduction into the United States of the bessemer process for the production of steel, and by the establishment and development of steel plants which became the greatest in the world, he made available for engineers the most useful modern material for engineering construction. In the successful conduct of many industrial enterprises he amassed great wealth, the possession of which he came to regard with deep seriousness as a public trusteeship. While yet in full possession of his faculties, he devoted himself to the distribution of large portions of his fortune to projects for the benefit of mankind. He distributed his wealth not only in many directions, but also with the exercise of great wisdom based on careful investigation. His munificence provided large funds for the building of a home for the great national engineering societies and many associate societies. He was an honorary member of the American Institute of Mining and Metallurgical Engineers and American Society of Mechanical Engineers. He was personally known and loved by many engineers.

In view of these facts, be it

Resolved, that the American Societies of Civil, Mining, Metallurgical, Mechanical and Electrical Engineers, the United Engineering Society, and the Engineers' Club herein express their condolence to the family of Mr. Carnegie and record their sincere appreciation of the great contributions of Andrew Carnegie to the advancement of engineering, and of his friendly assistance in making possible beautiful homes for the Engineering Societies and the Engineers' Club, thus fostering the spirit of unity in the profession.

The committee is composed of Charles F. Rand, chairman; Dr. Alexander C. Humphreys and Calvin W. Rice for the founder societies; Lansing C. Holden, Robert A. Franks and E. Gybbon Spilsbury for the Engineers' Club.

At the meeting it was also voted that the chairman appoint four men to serve with himself as a committee to determine whether there should be a memorial to Mr. Carnegie by the engineering societies, and if so which form it should take, the committee to have power to make the necessary arrangements and carry them through. The members of the committee are Charles F. Rand, Lansing C. Holden, W. L. Saunders, J. A. Bensel and Prof. Comfort A. Adams.

Daylight-Saving Repeal Passed Over President's Veto

Repeal of the Daylight-Saving Law was passed by the House of Representatives, over the President's veto, by a vote of 223 to 101, Aug. 19.

In returning the measure for the second time without his signature, the President said he did so with "the utmost reluctance."

The President's message vetoing the bill follows:

"To the House of Representatives:

"I return this bill, H. R. 3854, 'An Act for the Repeal of the Daylight-Saving Law,' without my signature, but do so with the utmost reluctance. I realize the very considerable, and, in some respects, very serious inconveniences to which the daylight-saving law subjects the farmers of the country, to whom we owe the greatest consideration. But I have been obliged to balance one set of disadvantages against another. The immediate and pressing need of the country is production, increased and increasing production, in all lines of industry.

"The disorganization and dislocation caused by the war have told nowhere so heavily as at the industrial centers.

"It is to these that the daylight-saving law is of most service. It ministers to economy and to efficiency. And the interests of the farmer are not in all respects separated from these interests. He needs what the factories produce, along with the rest of the world. He is profited by the prosperity which their success brings about. His own life and methods are more easily adjusted, I venture to think, than those of the manufacturer and the merchant."

The Senate by a vote of 57 to 19 concurred in the action of the House.

Agitation for the repeal of the daylight-saving law first came from farmers, but recently some labor unions have come out in favor of the repeal measure.

Crane to Represent Associated General Contractors

Arrangements have been made to have C. A. Crane, secretary of the New York General Contractors' Association, represent the Associated General Contractors in New York territory. Offices of the Associated General Contractors of America, formerly at 1416 Broadway, have been moved to 51 Chambers St., New York City. L. L. Warfield, until recently Eastern field secretary, is no longer connected with the organization.

Bonus for Quartermaster Civilian Construction Employees

Through the activities of the Union of Technical Men, civilian employees in the Construction Division of the Quartermaster's Office will receive a $240 bonus, effective July 1, 1919. The bonus is given in accordance with an act of Congress approved Mar. 1, 1919.

On Mar. 10, 1919, the Union of Technical Men wrote to the Secretary of War, calling attention to the fact that employees in the storage office, Port of New York, Quartermaster Department, had received advanced salaries in accordance with a circular issued by the War Department July 27, 1918. After considerable correspondence with various branches of the Army the union recently received notice that a satisfactory adjustment had been made.

Civil Service Examinations

Canada—Junior engineer, Department of Public Works, Prince Rupert, B. C., $1680 per year. Application forms may be obtained from the offices of the Employment Service of Canada or the Secretary of the Civil Service Commission, Ottawa, and must be filed not later than Aug. 29.

United States

For United States civil service examinations, listed below, apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the commission, for form 1312.

Patent investigator, patents section, War Department, $1200 to $1800 per year. File applications before August 26.

Expert patent investigator, patents section, War Department, $1800 to $2400 per year. File applications before Aug. 26.

Research engineer, $2,800 to $3,200 per year, Ordnance Department. File application before Sept. 2.

Research physicist, $2,700 to $3,200 per year, Ordnance Department. File application before Sept. 2.

Mathematics and dynamics experts, Grade I, $2,500 to $4,000 per year; Grade II, $4,000 to $5,000 per year, Ordnance Department. File application before Sept. 2.

Specification engineer, $2,400 per year; Chief Signal Officer's Office, War Department. File application before Sept. 9.

Chief metallurgist, $4,500 to $5,000 per year; assistant chief metallurgist, $3,600 to $4,500 per year, Ordnance Department. Applications must be filed before Sept. 16.

Junior highway bridge engineer, Office of Public Roads and Rural Engineering, Department of Agriculture, $1200 and $1600 per year, Sept. 17.

Computer, Ordnance, Navy Yard, Washington, D. C., $7.20 to $12 per diem, Sept. 17. File applications in time to arrange for examination at place selected by applicant.

Assistant examiner, Patent Office, Washington, D. C., $1500 to $1740 per year, Sept. 17 to 19 and Nov. 19 to 21. File applications in time to arrange for examination at place selected by applicant.

Engineer, $3000 per year; assistant engineer, $1800 to $2880 per year; junior engineer, $1200 to $1740 per year; engineering draftsman, $1200 to $3000 per year, Reclamation Service. Applications will be received until further notice.

ENGINEERING SOCIETIES

Calendar

Annual Meeting

NEW ENGLAND WATER WORKS ASSOCIATION Tremont Temple, Boston. Sept. 30, Oct. 1-3. Albany, N. Y.

AMERICAN SOCIETY OF NAVAL ENGINEERS; Secretary, Lieut. Com. F. W. Sterling, U. S. N., Navy Department, Washington, D. C.; Oct. 7, Washington.

AMERICAN PUBLIC HEALTH ASSOCIATION; 169 Massachusetts Ave., Boston; Oct. 27-30, New Orleans.

The **San Francisco Chapter of the American Association of Engineers**, at its meeting **Aug. 7**, discussed plans for appointing a Western secretary, for entertaining **F. H. Newell**, the national president of the organization on the occasion of his San Francisco visit, and ways and means for promoting the interests of association members.

The **North Carolina Society of Civil Engineers** will hold its first annual convention at Wrightsville Aug. 22-23. Col. Joseph Hyde Pratt, U. S. A., will speak on "Lessons Learned from Roads in France." There will also be a discussion of North Carolina drainage problems and highway construction.

The **Sacramento Chapter of the American Association of Engineers**, at its meeting Aug. 5, authorized a committee, composed of R. E. Dodge and R. Walsh, to take preliminary action toward organizing a State Council of Engineers. The qualification committee reported the following as newly elected officers: President, W. S. Carruthers; vice-presidents, F. B. Gillette, R. Walsh and G. H. P. Lichthardt; secretary-treasurer, H. A. Lathrop. A special committee was appointed to arrange suitable entertainment when the chapter receives President Newell of the association.

PERSONAL NOTES

CAPT. BRUCE ALDRICH, U. S. A., has been appointed district engineer for the Asphalt Association for Canada, with headquarters at the office of the H. K. McCann Co., Ltd., Toronto, Ont. Mr. Aldrich was formerly in the office of the inspector of asphalt and cement, engineer department, District of Columbia, and later was engaged by the City of Baltimore, where he organized and equipped the municipal laboratory in which were tested all materials entering into new paving. As inspector of asphalts he supervised the laying of more than 3,000,000 sq.yd. of sheet asphalt and bituminous concrete, having on occasions as many as seven asphalt plants working at one time. He recently returned from service in France to his former position in Baltimore, from which he resigned to accept the position with the Asphalt Association, 15 Maiden Lane, New York.

ARTHUR H. BLANCHARD has been appointed professor of highway engineering at the University of Michigan, to occupy the chair recently established by the Board of Regents. He will retain his consulting office at Broadway and 117th St., New York City, until Sept. 15, after which he will be located in Ann Arbor, Mich.

CAPT. W. S. WYCHE, 2nd Engineers, U. S. A., has returned from overseas and has rejoined the Arkansas Valley Railway, Light & Power Co., Victor, Colo. He was decorated with the Croix de Guerre and palm.

THE HON. F. B. CARVEL, former Canadian minister of public works, has taken up his new duties as chairman of the Canadian Board of Railway Commissioners, succeeding Sir Henry Drayton, who has been appointed minister of finance.

M. NAKAMURA, engineer, of Tokio, is visiting Canada studying power development, and obtaining information on Canadian manufacturing plants. He states that interest in Japan in the development of electric power is very keen.

A. W. MACPHERSON, for the past 15 years on the engineering staff of the San Francisco-Oakland Terminal Rys., of five of which he was chief engineer, has resigned to take up ranching. He contemplates the organization soon of a general contracting firm.

H. S. MCFADDEN, formerly with the Kansas State Highway Commission, is the president of the newly-organized KANSAS ENGINEERING CO., Topeka, Kan. The firm will specialize in road-surveys.

J. A. CAMPBELL, JR., and C. B. MCKEY are president and secretary, respectively, of the WESTERN ENGINEERING CO., Topeka, Kan., recently organized to handle Federal-aid road work.

BLAIR BOYLE, county engineer of Geary County, Kansas, has resigned to become county engineer for Bourbon County, Kansas, with headquarters at Fort Scott.

MAJ. ARTHUR H. PRATT, 26th Engineers, U. S. A., has been discharged from the Army and has been appointed designing engineer for the North Jersey District Water-Supply Commission, which is developing the Wanaque River at Midvale, N. J., to supply Newark and neighboring municipalities.

MAJ. E. A. KINGSLEY, Engineers, U. S. A., has just returned from France and has resumed his engineering practice at San Antonio, Tex. He left for France in September, 1917, and in October was assigned to the road department of the A. E. F. In January, 1918, he was made superintendent of roads for the intermediate section of the Army's lines of communication, from which position he was relieved in June of this year. All of the road construction and maintenance in the section were under his supervision. In 1904 Major Kingsley left railroad service to become engineer of Little Rock, Ark. Retiring from this position in 1911, he was appointed the county engineer at Little Rock, and two years later the first state highway engineer of Arkansas. He entered private practice in 1914, so continuing until he was commissioned in the Army in 1917.

CAPT. HOWARD F. BRONSON, U. S. A., for two years camp sanitary engineer at Camp Upton, Long Island, has received his discharge from the Army to return to the Pennsylvania State Department of Health as sanitary engineer in the engineering division.

A. M. CRAIN, of Detroit, has become associated with the Witherspoon-Englar Co., engaged in building construction, Chicago, as vice-president. He was formerly a member of the firm of Janse Bros., Boomer, Crain & Howe. He will continue his work of specialization in the construction of grain elevators, power plants, industrial buildings and railway terminals.

HARTLEY ROWE, formerly in charge of building and design work in the Canal Zone for the United States Government, has been placed in charge of the new Detroit offices of LOCKWOOD, GREEN & CO., consulting engineers, New York City.

FRANK H. JOYNER, until recently road commissioner of Los Angeles County, Calif., and before his appointment to that position division engineer of the Massachusetts State Highway Commission, has become chief engineer of the California Willite Road Construction Co., and consulting engineer of the Western Willite Road Construction Co., Los Angeles.

CAPT. EDWARD VAN WINKLE, 24th Engineers, U. S. A., has received his discharge from the service and is now associated with FREDERICK A. WALDRON, consulting engineer, 37 Wall St., New York City. He will give special attention to industrial engineering.

T. H. JOHNSON, whose resignation as city engineer of Sioux City, Iowa, was announced in these columns last week, has entered private practice.

LIEUT. GEORGE A. GIORLOFF, U. S. A., has received his discharge from the service and has become associated with the Towanda Construction Co. as superintending engineer on state highway construction near Towanda, Penn.

N. M. LONEY has resigned as chief engineer of the American Can Co. and has been elected vice-president of the Thompson-Starrett Co., New York City. C. G. PREIS, assistant chief engineer, succeeds Mr. Loney as chief engineer.

CHARLES C. SMITH has resigned as city engineer of San Angelo, Tex., to become county engineer of Schleicher County, Texas.

WARREN B. BURCH, city engigineer of San Luis Obispo, Calif., for the past four years, has become county engineer of San Luis Obispo County.

WILLIAM J. D. LYNCH has resigned as assistant engineer of Nutley, N. J.

W. H. RAMP has resigned as city engineer of Parkersburg, W. Va. He will be employed by the North Carolina State Highway Department.

A. V. HOOKS, formerly assistant engineer of the Southern R.R., and recently discharged from the military service, has become resident engineer of the eastern district of the Southern Railroad.

GEORGE S. DUKS, it was announced in these columns recently, had been admitted into partnership with McClean & Wheaton, contractors, Moncton, N. B. Mr. Duks states that he has no relationship with the firm.

Track-Laying Tractor Crane of Ordnance Department

Among the various automotive units shown by the Army Ordnance Department at the summer meeting of the Society of Automotive Engineers at Ottawa Beach, the track-laying crane shown in the accompanying illustration shows possibilities for civilian use. The crane is shown lifting one of the three-ton tanks by the lifting rings provided for the purpose. The crane is also provided with a winch, which may be seen at the foot of the boom.

With the type of tread fitted to this machine, its usefulness is not limited by the nature of the ground over which it must work, as it can go practically anywhere. The low bearing pressure of the tracks permit its use in soft mud or snow where any other vehicle would be hopelessly mired. It is thought that such a device would be useful around large industrial works where it is necessary to lift heavy boilers and where, due to the progress of construction, unstable soil conditions would be likely to exist. The apparatus shown in the illustration is equipped with caterpillar tread as manufactured by the Holt Manufacturing Co., Peoria, Ill.

NEW TRACK-LAYING TRACTOR CRANE

BUSINESS NOTES

THE BUCYRUS CO., South Milwaukee, Wis., has opened an office at Pittsburg, Kan., for supplying electric- and steam-shovel spare parts to coal-stripping contractors and coal-mining companies operating in the Pittsburg district. The office is in charge of A. M. Neilsen.

THE GOULD MANUFACTURING CO., manufacturers of pumps, Seneca Falls, N. Y., has opened a district sales office in Detroit, Mich. This office will be located in the Dime Bank Bldg., and will be in charge of E. B. Gould, who recently returned from service in France.

THE BEDFORD FOUNDRY & MACHINE CO., Bedford, Ind., has appointed J. N. Kinney, contracting engineer, 30 Church St., New York City, as its New York representative.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., East Pittsburgh, Penn., has appointed A. B. Reynders as works manager of its East Springfield plant. Mr. Reynders was formerly director of production of the company at East Pittsburgh, and has been in the employ of the company since 1899. A. E. Kaiser, who has been assistant to the director of production since 1912, has been made director of production, to take Mr. Reynders' place.

THE CLINTON WIRE CLOTH CO., THE WRIGHT WIRE CO., THE MORGAN SPRING CO. and THE NATIONAL MANUFACTURING CO. have combined forces and coördinated manufacturing plants and facilities for greater service in supplying the wire and wire products manufactured by these companies. The organizations that have served in the past are to continue as before. The administrative offices will be at Worcester, Mass. The firm name will be the Clinton-Wright Wire Company.

THE READING ENGINEERING CO. has been organized by Eugene P. Reading, formerly with the Hubbard - Floyd Co., and will carry on a general equipment business, with offices in the Tribune Bldg., 154 Nassau St., New York.

THE NORTON CO. and the NORTON GRINDING Co., Worcester, Mass., will hereafter be conducted under the firm name of the Norton Co. under the direction of Charles L. Allen, president and general manager. The following appointments have been made: Vice-president and general sales manager, Carl F. Dietz; vice-president and foreign manager, W. LaCoste Neilson; sales manager, grinding-wheel division, Herbert Duckworth; sales manager, grinding-machine division, Howard W. Dunbar; superintendent, grinding-machine division, John C. Spence; chief engineer, grinding-machine division, Charles H. Norton.

THE SULLIVAN MACHINERY CO. announces the appointment of R. S. Weiner as district manager at El Paso, Tex., succeeding Don M. Sutor. Mr. Sutor has been transferred to the company's St. Louis office as district manager.

THE SOUTHERN CALIFORNIA IRON & STEEL CO. will begin immediate construction of a new plant at Huntington Park, on a site of 25 acres lying between the lines of the Salt Lake and Pacific Electric Ry., it is reported. The investment represented will be, roughly, $1,750,000. The officers of the company are A. C. Denman, Jr., president and general manager; E. G. Pratt, vice-president; S. K. Rindge, treasurer; A. W. Grier, secretary, and George B. Stephens, superintendent.

TRADE PUBLICATIONS

The following companies have issued trade publications:

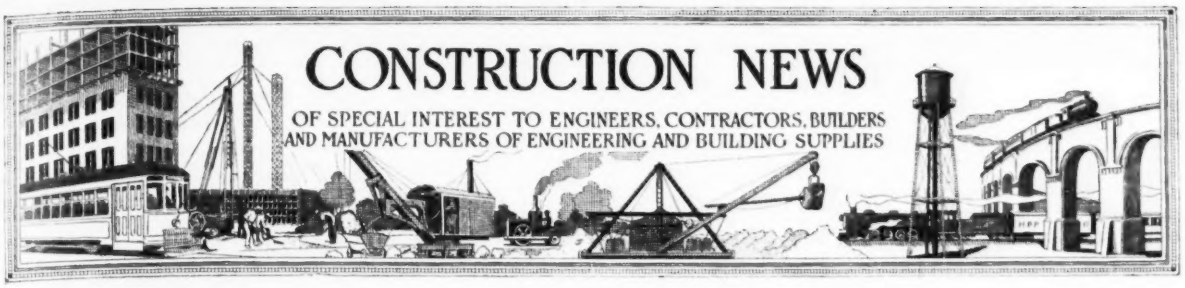
THE PELTON WATER WHEEL CO., San Francisco and New York; bulletin No. 12, 7¾ x 10½ in., 48 pages, illustrated; describes centrifugal pumps and their installation.

THE INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Boulevard, Chicago, Ill.; folder, 6 x 9 in., six pages, illustrated; describes hose couplings.

THE R. F. CARPENTER MFG. CO., 978 E. 64th St., Cleveland, Ohio; folder, 8½ x 11 in., four pages, illustrated; describes interior steel dividing partitions for offices and factories.

THE OSGOOD CO., manufacturer of excavating machinery, Marion, Ohio; catalog, 8½ x 11¼ in., 31 pages, illustrated; tells of the use of the company's steam shovels upon various work.

THE TROY WAGON WORKS CO., Troy, Ohio; booklet, 4 x 8 in., 57 pages; contains articles and letters from various firms and persons dealing with profit-sharing and bonus systems as applied to trucks, trailers, taxi and bus lines. The articles are illustrated with forms used in carrying out the various systems in use. Throughout, emphasis is laid on the human element, as well as the importance of keeping accurate cost records.


CONSTRUCTION NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

PROPOSALS

"For Proposals Advertised see the pages immediately following the Construction News Section."

WATERWORKS

Bids Close		See Eng. News-Record
Aug. 25	Grey Bull, Wyo.	Aug. 14
Aug. 25	Williamston, N. C.	Aug. 21
Aug. 25	Royal Oak, Mich.	Aug. 14
Aug. 26	Dalhousie, N. B.	Aug. 21
Aug. 29	Spirit Lake, Ia.	Aug. 21
Aug. 30	Berwick, N. S.	Aug. 14
Aug. 30	Clarksburg, W. Va. Adv. Aug. 7.	Aug. 7
Sept. 17	Kansas City, Mo.	Aug. 21

SEWERS

Aug. 25	Walnut Grove, Minn.	Aug. 7
Aug. 25	Lima, O. Adv. Aug. 7.	Aug. 7
Aug. 25	Royal Oak, Mich.	Aug. 14
Aug. 25	Fairhaven, Mass. Adv. Aug. 14.	Aug. 14
Aug. 26	Hartley, Ia.	Aug. 21
Aug. 28	New York, N. Y.	Aug. 21
Sept. 1	Walnut Grove, Minn.	Aug. 21
Sept. 1	Inwood, Ia.	Aug. 21
Sept. 3	Pocahontas, Ia.	Aug. 21
Sept. 4	Richmond, Ky. Adv. Aug. 21.	Aug. 21

BRIDGES

Aug. 25	Willoughby, O.	Aug. 7
Aug. 25	Great Falls, Mont.	Aug. 7
Aug. 25	Underwood, Wash.	Aug. 14
Aug. 25	Washington, Pa.	Aug. 21
Aug. 26	Kingwood, W. Va.	Aug. 21
Aug. 26	Lockhart, S. C. Adv. Aug. 14.	Aug. 14
Aug. 26	Salt Lake City, Utah.	Aug. 21
Aug. 26	Lagrange, Ga.	Aug. 21
Aug. 26	Charleston, Mo.	Aug. 21
Aug. 27	Monroe, Ga.	Aug. 21
Aug. 29	Beaufort, S. C.	Aug. 21
Aug. 29	Watertown, N. Y. Adv. Aug. 21.	Aug. 21
Sept. 1	Duluth, Minn.	Aug. 14
Sept. 2	Chester, S. C.	Aug. 21
Sept. 2	Minneapolis, Minn.	Aug. 14
Sept. 2	Blue Earth, Minn.	Aug. 21
Sept. 3	Dubois, Pa.	Aug. 21
Sept. 3	Three Rivers, Cal.	Aug. 21
Sept. 3	Toledo, O.	Aug. 14
Sept. 9	Duluth, Minn.	Aug. 14
Sept. 12	Schenectady, N. Y. Adv. Aug. 21.	Aug. 21
Sept. 16	Wayne, W. Va.	Aug. 21
Sept. 23	Harrisburg, Pa. Adv. Aug. 14.	Aug. 14

STREETS AND ROADS

Aug. 25	Ebensburg, Pa.	Aug. 7
Aug. 25	Indiana	Aug. 14
Aug. 25	Washington	Aug. 14
Aug. 25	California	Aug. 14
Aug. 25	Louisiana	Aug. 21
Aug. 25	Seguin, Tex.	Aug. 21
Aug. 25	Mt. Pleasant, Mich.	Aug. 21
Aug. 25	New York, N. Y.	Aug. 21
Aug. 25	Portland, Ore.	Aug. 21
Aug. 26	Charleston, Mo.	Aug. 21
Aug. 26	Michigan	Aug. 21
Aug. 26	North Carolina	Aug. 21
Aug. 26	Indiana	Aug. 14
Aug. 26	Maryland	Aug. 14
Aug. 26	Bordentown, N. J. Adv. Aug. 14.	Aug. 14
Aug. 26	Trenton, N. J. Adv. Aug. 14.	Aug. 14
Aug. 26	New York, N. Y.	Aug. 7
Aug. 26	Guntersville, Ala.	July 31
Aug. 27	Long Island City, N. Y.	Aug. 21
Aug. 27	Peru, Neb.	Aug. 7
Aug. 27	Welch, W. Va.	Aug. 14
Aug. 27	Middletown, Del.	Aug. 14
Aug. 27	New Jersey Adv. Aug. 14.	Aug. 14
Aug. 27	Princeton, W. Va.	Aug. 21
Aug. 28	New York, N. Y.	Aug. 21
Aug. 28	St. Armand, Que.	Aug. 21
Aug. 28	Brooklyn, N. Y.	Aug. 21
Aug. 28	Helena, Ark.	Aug. 14
Aug. 28	Martinsburg, W. Va.	Aug. 14
Aug. 28	Camden, N. J. Adv. Aug. 14.	Aug. 14
Aug. 28	Xenia, O.	Aug. 21
Aug. 28	Edgefield, S. C.	Aug. 21
Aug. 29	Greenfield, Ind.	Aug. 14
Aug. 29	Port Arthur, Tex.	Aug. 21
Aug. 29	Ebensburg, Pa.	Aug. 21
Aug. 30	Berkeley Springs, W. Va.	Aug. 21
Aug. 30	St. Martine, Que.	Aug. 14
Sept. 1	Arcadia, Fla.	Aug. 7
Sept. 1	Salt Lake City, Utah	July 24
Sept. 1	Alexandria, La.	Aug. 21
Sept. 2	Waterville, Wash.	Aug. 21
Sept. 2	Pascagoula, Miss. Adv. Aug. 21	Aug. 21
Sept. 2	North Carolina	Aug. 21
Sept. 2	Louisiana	Aug. 21
Sept. 2	Independence, Mo.	Aug. 7
Sept. 2	Minneapolis, Minn.	Aug. 14
Sept. 2	Washington, Ga.	Aug. 14
Sept. 2	Sylacauga, Ala.	Aug. 14
Sept. 2	Maryland Adv. Aug. 21.	Aug. 21
Sept. 3	Maine	Aug. 21
Sept. 3	Toledo, O.	Aug. 14
Sept. 3	Moultrie, Ga.	Aug. 14
Sept. 4	Fulton, Mo.	Aug. 21
Sept. 4	Rochester, N. Y. Adv. Aug. 21.	Aug. 21
Sept. 5	Little Rock, Ark.	Aug. 21
Sept. 8	Seattle, Wash.	Aug. 21
Sept. 8	Indiana	Aug. 14
Sept. 8	Monroe, Ga.	Aug. 21
Sept. 9	New York, N. Y. Adv. Aug. 21.	Aug. 21
Sept. 9	Keyser, W. Va. Adv. Aug. 21	Aug. 21
Sept. 9	Jersey City, N. J.	Aug. 21
Sept. 10	Bentonville, Ark.	Aug. 21
Sept. 10	Delaware Adv. Aug. 21	Aug. 21
Sept. 10	Waterloo, Ia.	Aug. 21
Sept. 16	Prosser, Wash.	Aug. 21
Sept. 16	New Orleans, La.	Aug. 21
Sept. 18	Marion, Ark.	Aug. 21
Oct. 10	Tacoma, Wash. Adv. Aug. 14.	Aug. 14

EXCAVATION AND DREDGING

Aug. 25	New York, N. Y.	Aug. 21
Aug. 26	Emmetsburg, Ia.	Aug. 21
Aug. 28	Granite Falls, Minn.	Aug. 7
Sept. 2	Sanford, Ala.	Aug. 14
Sept. 5	Fort Dodge, Ia.	Aug. 21
Sept. 10	Toms River, N. J.	Aug. 21
Sept. 22	Tower, Minn.	Aug. 21

INDUSTRIAL WORKS

Aug. 23	Philadelphia, Pa.	Aug. 21
Sept. 1	Hastings, Minn.	Aug. 21

BUILDINGS

Aug. 25	Elizabeth, N. J.	Aug. 7
Aug. 25	Bayard, Neb.	Aug. 7
Aug. 25	Chicago, Ill.	Aug. 7
Aug. 25	Dongan Hills, S. I., N. Y.	Aug. 21
Aug. 25	Richmond, Va.	Aug. 21
Aug. 26	Williamsport, Pa.	Aug. 21
Aug. 26	Oklahoma	Aug. 21
Aug. 26	Weyburn, Sask.	Aug. 7
Aug. 26	Manhattan, Kan.	Aug. 14
Aug. 27	East White Plains, N. Y.	Aug. 14
Aug. 27	Stoutsville, O.	Aug. 7
Aug. 27	Toronto, Ont.	Aug. 21
Aug. 28	Amos, Que.	Aug. 21
Aug. 29	Toronto, Ont.	Aug. 21
Aug. 30	Northfield, Minn.	Aug. 21
Aug. 30	New Aberdeen, N. S.	Aug. 7
Aug. 30	Worcester, Mass.	Aug. 14
Aug. 30	Halifax, N. S.	Aug. 14
Sept. 1	St. Louis, Mo.	Aug. 21
Sept. 1	Omaha, Neb.	July 17
Sept. 1	Ft. Worth, Tex.	Aug. 14
Sept. 1	Cameron, Tex.	Aug. 14
Sept. 1	Miamisburg, O.	Aug. 14
Sept. 1	Outremont, Que.	Aug. 14
Sept. 1	Willmar, Minn.	Aug. 21
Sept. 2	Twin Falls, Idaho	Aug. 21
Sept. 2	Merced, Cal.	Aug. 21
Sept. 2	Okmulgee, Okla.	Aug. 21
Sept. 3	Trenton, N. J.	Aug. 14
Sept. 3	Victoria, Tex.	Aug. 14
Sept. 4	Hartsdale, N. Y.	Aug. 21
Sept. 4	Bayonne, N. J.	July 31
Sept. 4	Peterborough, Ont.	Aug. 14
Sept. 4	Lyndon, Kan.	Aug. 21
Sept. 4	Troy, N. Y.	Aug. 21
Sept. 5	San Francisco, Cal.	Aug. 21
Sept. 6	Fairview, Pa.	Aug. 14
Sept. 11	Minneapolis, Minn.	Aug. 21
Sept. 11	Superior, Wis.	Aug. 21
Sept. 12	Cloquet, Minn.	Aug. 21
Sept. 15	Pleasant Grove, Utah.	July 24
Sept. 15	St. Paul, Minn.	Aug. 14

FEDERAL GOVERNMENT WORK

Aug. 25	Fuel Oil—Washington, D. C.	Aug. 14
Aug. 25	Post Office—Mystic, Conn.	July 31
Aug. 26	Dredging—Honolulu, H. T. Adv. June 26.	June 26
Aug. 27	Sea Wall — New York, N. Y. Adv. July 31.	July 31
Aug. 27	Equipment—New Orleans, La.	Aug. 21
Aug. 27	Electric Lighting and Power System, Spec. 3982, Mare Island, Cal.	Aug. 14
Aug. 27	Dredging—Norfolk, Va. Adv. July 31.	July 31
Aug. 27	Lock and Abutment — Louisville, Ky. Adv. July 31.	July 31
Aug. 28	Road Work — Aberdeen, Md. Adv. Aug. 21.	Aug. 21
Aug. 29	Post Office—Fayette, Mo.	July 24
Aug. 29	Dredging — New York, N. Y. Adv. July 31.	July 31
Aug. 29	Breakwater—Chicago, Ill. Adv. Aug. 7.	Aug. 7
Aug. 30	Road Work—Montana	Aug. 21
Sept. 2	Towboat—Memphis, Tenn.	Aug. 7
Sept. 2	Miscellaneous Equipment—Washington, D. C. Adv. July 10 and 17.	July 10
Sept. 2	Post Office—Kansas City, Mo.	July 24
Sept. 2	Dredging—New York, N. Y. Adv. Aug. 7.	Aug. 7
Sept. 4	Boiler Plant — Stapleton, N. Y. Adv. Aug. 21.	Aug. 21
Sept. 4	Bridge—Arizona	Aug. 21
Sept. 5	Post Office — Montevideo, Minn.	Aug. 14
Sept. 7	Alterations to Post Office—Detroit, Mich. Adv. Aug. 21	Aug. 21
Sept. 8	Hangar—Lakehurst, N. J. Spec. 4001	Aug. 21
Sept. 8	Post Office—Carroll, Ia.	Aug. 14
Sept. 10	Post Office—Douglas, Ga.	July 31
Sept. 10	Water and Sewer Systems and Fuel Oil Reservoir—Spec. 4007, San Diego, Cal.	Aug. 21
Sept. 11	Earthwork — Memphis, Tenn. Adv. Aug. 21	Aug. 21

Bids Close		See Eng. News-Record
Sept. 12	Remodeling Electric Passeager Elevator — Chicago, Ill. Adv. Aug. 21	Aug. 21
Sept. 12	Pumps — New Haven, Conn. Adv. Aug. 21.	Aug. 21
Sept. 15	Earthwork—St. Louis, Mo. Adv. Aug. 21	Aug. 21
Sept. 15	Post Office—Winnemucca, Nev. Adv. Aug. 21	Aug. 21
Sept. 15	Kitchen and Mess Hall — Stapleton, N. Y. Adv. Aug. 21.	Aug. 21
Sept. 18	Jetty Repair — Wilmington, Del. Adv. Aug. 21	Aug. 21
Sept. 18	Post Office—North Topeka Kan.	Aug. 14
Sept. 22	Material—Charlestown, W. Va.	Aug. 21
Sept. 22	Post Office — Charleston, W. Va.	Aug. 21
Sept. 26	Post Office and Custom House—Providence, R. I. Adv. Aug. 21.	Aug. 21
Oct. 1	Valves, Gates, etc.—Denver, Colo. Adv. Aug. 21	Aug. 21
Nov. 3	Post Office and Court House —Honolulu, H. T.	Aug. 21

MISCELLANEOUS

Aug. 25	Railway Ties — Toronto, Ont.	Aug. 7
Aug. 25	Cistern—Duluth, Minn.	Aug. 21
Aug. 26	Column Foundations—Philadelphia, Pa.	Aug. 14
Aug. 28	Silo—Savannah, Ga.	July 24
Aug. 28	Wharf—Sillery, Que.	Aug. 14
Aug. 29	Water Machinery—Trenton, N. J.	Aug. 21
Aug. 29	Protection Works — Laprairie, Que.	Aug. 21
Sept. 2	Sewage Pumping Machinery —Los Angeles, Cal.	Aug. 21
Sept. 2	Pier Shed—Seattle, Wash.,	Aug. 21
Sept. 2	Bulkhead, Wharf and Shelter Sheds, Wilmington, Del. Adv. Aug. 21	Aug. 21
Sept. 5	Pump—Bruce, S. D.	Aug. 21
Sept. 12	Dam—Decatur, Ill.	Aug. 14
Sept. 15	Levee—Alexandria, La.	Aug. 14
Sept. 23	Turbines, etc.—Saskatoon, Sask. Adv. July 24.	July 24

Where name of official is not given, inquiries should be addressed to City Clerk, County Clerk or corresponding official.

Waterworks

PROPOSED WORK

Va., Orange—Town voted $70,000 bonds to improve waterworks system, including filter plant, pumping equipment and force main. A. J. Harlow, mayor.

N. C., Franklinton—City soon receives bids building waterworks system. About $40,000. Engineer not selected.

S. C., Mullins—City will sell $20,000 bonds Sept. 1 to build waterworks and sewerage systems. Engineer not selected.

O., Columbus—City Council will be asked to appropriate funds for extending waterworks system, as recommended by J. H. Gregory, engr. Plans include new 67 ft. dam, 6,120,000,000 gal. capacity, in Scioto River above Dublin, cost $1,250,000, raising present dam 6 ft., $297,000, and reinforcements for distributing system, $550,000.

Mich., Ecorse—Village soon lets contract building elevated steel tank with capacity of 150,000 gal., 2 motor driven centrifugal pumps, with capacity of 500 gal. per minute, rein.-con. reservoir, 500,000 gal. capacity, and 8000 ft. water pipe. Separate bids on steel tank and on rest of job complete. R. A. Murdock, 706 Free Press Bldg., Detroit, engr.

Mich., River Rouge—Village soon lets contract furnishing labor and materials laying 4330 ft. 6 in. and 580 ft. 8 in. water pipe with specials and hydrants, to connect with Detroit city mains. About $15,000. G. Jerome, 1331 Majestic Bldg., Detroit, engr.

Minn., Mankato — City Council authorized $12,000 bonds to build waterworks.

Kan., Chanute — City voted $250,000 bonds to build waterworks and electric light plant.

Kan., Cherryvale—City plans to build extension to waterworks. About $40,000. Black & Veatch, Interstate Bldg., Kansas City, Mo., engrs.

Kan., Pretty Prairie — City election Aug. 28, to vote on $32,000 bonds to build waterworks. W. B. Rollins & Co., 209 Royal Exch., Kansas City, Mo., engrs.

Okla., Enid—CIty voted $320,000 bonds to build waterworks. Engineer not selected.

Utah, Provo—City plans to install 4 mi. 12 in. pipes from here to Pleasant View. About $20,000. R. Ferrer, supt. of waterworks.

Ariz., Phoenix—City had plans prepared for rein.-con. water conduit from Central to 3rd Aves. About $28,000. L. B. Hitchcock, city engr.

Ariz., Roosevelt—Salt River Valley Water Users Assn., Phoenix, plans to build 5000 k.w. steam generating plant for furnishing power to about 60 pumps which will be used to lower underground water level. C. A. Van der Verr, secy.

Cal., Arcadia—City voted $150,000 bonds to sink well, build 1,000,000 gal. concrete reservoir and smaller reservoir, lay 15 mi. pipe line and install 2 booster pumps and 1 pump at well. H. S. Gierlich, city engr. Noted May 22.

Cal., Oildale—Oildale Water Dist. No. 1 voted $20,000 additional bonds, making a total of $40,000, to sink wells, install pumps and lay pipe lines. Bids will soon be received. A. E. Stegeman, Bakersfield, co. surv. Noted Mar. 20.

Cal., San Diego—W. W. Patch, div. engr., state highway comn., Union League Bldg., Los Angeles, plans to build 15 mi. pipe line to bring water from Boundary Creek to Tecate Divide State Highway, San Diego Co. About $20,000.

Ont., Chatham—City having preliminary surveys, reports and estimates prepared by James, Loudon & Hertzberg, engrs., 36 Toronto St., Toronto, for new waterworks system, including intake, pumphouse, 5,000,000 gal. capacity rein.-con. reservoir, etc. About $200,000.

Ont., Forest—Town plans to build waterworks system to include electrically driven pumping equipment. Bylaw for same to be submitted soon. James, Loudon & Hertzberg, Excelsior Life Bldg., Toronto, engrs.

BIDS DESIRED

N. C., Williamston—Until Aug. 25, by Mayor, building complete waterworks and sewerage systems, including concrete or steel reservoir, water tower, 10 mi. water mains and 10 mi. sanitary sewers. About $50,000. G. N. Ambler, Richmond, Va., engr.

Ia., Dexter—H. H. Hough, city clk., receiving bids building waterworks system, including one 40,000 gal. standpipe, one 15 h.p. oil engine, one 200 gal. per minute pump, 29,000 ft. 4 and 6 in. c.i. pipe and 26 hydrants, etc. T. S. DeLay, Creston, engr.

Mo., Kansas City—Until Sept. 17th, by city purch. agt., City Hall, building 1 steam driven pumping unit. W. G. Goodwin, engr. and supt.; advertised in this issue.

Mo., Marysville—Until Sept. 2, by city, building 2 reservoirs, rein.-con. coagulatory plant, rein.-con. storage plant, two 600 g.p.m. motor-driven pumps, and one 7000 g.p.m. low service pump, involving 360 cu.yd. rein.-con., 180 cu.yd. concrete and 30,000 cu.yd. excav. About $35,000. E. E. Harper, 2408 East 30th St., Kansas City, engr. Noted Aug. 14.

Tex., Port Arthur — Until Aug. 29, by L. A. Watter, city clk., furnishing and building 300,000 gal. elevated water tank. C. E. Ridley, city engr.

N. B., Dalhousie—Until Aug. 26, by F. W. Holt, engr., Canterbury St., St. John, building complete reservoir, here for city. About $35,000.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**N. C., Rutherfordton**—City let contract laying 7500 ft. 6 and 8 in. pipes, to J. E. Cogle, Rutherfordton; filter, to Norwood Eng. Co.; storage dam, clear water basin and pumps, to Gear & Wilson, Rutherfordton. Total cost $30,000.

★**Mich., Grosse Pointe**—Windmill Point Land Co., 2258 Penobscot Bldg., Detroit, let contract to T. H. Igelhart, 209 South La Salle Ave., Chicago, furnishing labor and material laying 20,000 ft. 6 and 8 in. watermains in company's subdivision, to be connected with Detroit city mains. About $100,000.

★**Wis., Milwaukee**—Central Bd. Purchases let contract building 20,000,000 gal. pumping engine for North Point Pumping Station, to Allis-Chalmers Co., West Allis. About $225,000. Noted June 26.

★**Minn., Farmington**—E. H. Dorsey, city recdr., let contract laying 4800 ft. 6 in. water mains with valves, hydrants and accessories, to J. G. Ray, Waseca, $12,710. Noted July 24.

★**Minn., New Prague**—J. T. Rynda, supt. waterworks system, let contract building 60,000 gal. steel tank, to Pittsburg Des Moines Steel Co., Des Moines, Ia. About $6200. Noted July 31.

★**Minn., St. Cloud**—City let contract furnishing and laying 17,600 ft. 8-12 in. water mains, to Gedney & Murphy, 612 Globe Bldg., Minneapolis, $68,750. Noted July 31.

★**Kan., Caldwell**—City let contract excavating and constructing buildings for waterworks, to T. C. Brooks & Son, Jackson, cost $14,700, furnishing cast iron piping, to Nat'l. Cast Iron Pipe Co., Commerce Bldg., Kansas City, Mo., $44,216.

★**Neb., Omaha**—Metropolitan Water Bd. let contract laying water mains, involving 1920 ft. 8 in. and 4911 ft. 6 in. c.i. pipes, to Katz Constr. Co., Brandeis Theatre Bldg. About $13,500.

★**Mo., St. Louis**—St. Louis Manufacturing Co., 5301 Natural Bridge Rd., let contract building skelton water tower, to A. H. Haeseler Bldg. & Contg. Co., Wainwright Bldg. About $8000.

Utah, Salt Lake City—City received bids building large conduit from reservoir in Parleys Canyon to Parleys High Line conduit, involving 15,850 ft. 48 in. cement pipes, 416 ft. 42 in. steel pipes, 24,000 ft. earth and 4000 ft. rock excav., from E. Smith, Kearns Bldg., $215,818; Gibbons & Reed, Kearns Bldg., $220,501; P. J. Moran, 850 South 2nd St. W., $185,673. Noted June 19.

Wash., Seattle—Bd. Pub. Wks. received bids Aug. 8, laying water mains in 12th Ave., N. E., et al, from G. Alfonso, 6th N. W. and West 88th Sts., cost $12,483; S. A. Mocerl, Seattle, $13,210; C. Christofaso, Seattle, $13,886.

★**Cal., Los Angeles**—Bd. Pub. Serv. Comn., 645 South Olive St., will build hydraulic fill dam, 85 ft. high, 1235 ft. long at top, containing 570,000 cu.yd. earthwork, on Los Angeles Aqueduct near Chatsworth Park, to be known as San Fernando Reservoir No. 1. Work will be done by day labor under supervision of W. Mulholland, engr., 645 South Olive St.

Sewers

PROPOSED WORK

N. Y., Salamanca—Bd. Pub. Wks. plans to build additions to sewerage system in southwestern section of city. About $21,000.

N. Y., Schenectady—City rejected all bids building storm and surface sewers in Union St., Woodland and Palmer Aves. Work will be readvertised. L. Sebring, city engr.

N. J. Bayonne—City soon receives bids building sewer in easterly side Hudson Blvd. between 45th and 46th Sts., together with all necessary appurtenances. About $10,000. C. J. O'Neil, clk.

N. J., Jersey City—City soon receives bids building 18 in. vitr. pipe sewer in Summit Ave., 85 ft. north of Honard Pl. to connect with sewer in Fairmont Ave. About $10,000. C. Van Kueren, city engr.

Sewers (Continued)

Pa., Smithton—Boro. Council receives bids about Aug. 25, laying 6700 ft. 4 in. pipe from Rostraver Twp. to South Huntingdon Twp. Reservoir adjacent to here. About $10,000. D. R. Walkenshaw, Greensburg, engr.

S. C., Mullins—See "Waterworks."

Mich., Muskegon Heights (Muskegon P. O.)—City having plans prepared by Hoad & Decker, engrs., Engineering Bldg., Ann Arbor, building system of vitr. crock lateral sewers, with connections, specials and manholes.

Mich., Pontiac—City having tentative plans prepared by C. W. Hubbell, engr., 2348 Penobscot Bldg., Detroit, building trunk line relief sewerage system for entire city. About $500,000.

Mich., Royal Oak—M. J. Brown & Son, engrs., 821 Chamber of Commerce Bldg., Detroit, received no bids furnishing labor and material building complete sewerage system and sewage disposal plant, involving 2200 ft. 8-10 in. vitr. crock sewers, Imhoff tank, ejector station and sprinkling filter, in Vinsetta Park subdivision for Vinsetta Land Co. About $25,000. Work will be readvertised. Noted Aug. 14.

Kan., Belle Plaine—City plans to build sewers in various streets. About $45,000. W. B. Rollins & Co., 209 Ry. Exch. Bldg., Kansas City, Mo., engrs.

Mo, St. Louis—J. W. Smith, engr., City Hall, soon receives bids extending Branch St. sewerage system. About $55,000.

Tex., Cleburne—City plans to build storm sewerage system. About $250,000.

Okla., Enid—City voted $180,000 bonds to build sewers. Engineer not selected.

Idaho, Rexburg—City council plans to install sewerage system throughout main streets. Vitr. or cement pipes. About $10,000.

Wash., Toppenish—City plans to build 10,000 ft. 8 and 10 in. sewers. Cost to exceed $10,000. M. Bartlett, Toppenish, engr.

Ore., Portland—City received no bids building sewers in East 77th St. from Oregon to Halsey Sts., and in East 76th St. from East Burnside to East Glisan Sts. About $10,000 each. O. Laurgaard, city engr. Noted Aug. 14.

BIDS DESIRED

N. Y., New York—Until Aug. 28, by H. Bruckner, pres. Bronx Boro., building storm water drain and appurtenances in East 23rd St. from Hutchinson River to Harper Ave., combined sewers and appurtenances in East 233rd St. from Harper to Monticello Aves., Pratt Ave. from East 233rd St. and North Line of City of New York, Bell Ave. between Pratt and Strang Aves., Duryea Ave. between East 233rd St. and Strang Ave., Amundsen Ave. between East 233rd St. and Strang Ave., Seton Ave. between East 233rd St. and the summit north of Strang Ave., Monticello Ave. between East 233rd St. and Strang Ave., Strang Ave. between Bell and Monticello Aves., and a temporary connection at East 233rd St. and Monticello Ave., also building sanitary sewers and appurtenances in Eden Terrace between Boston Rd. and property of City of New York at point midway between Crawford and Palmer Aves. and between Rattlesnake Creek and Eden Terrace from such point to a point about southeast corner of Eden Terrace and East 233rd St., and in East 233rd St. from such latter point to DeReimer Ave., DeReimer Ave. between East 233rd St. and Strang Ave. and combined sewers and appurtenances in Strang Ave. between Baychester and Grace Aves., Grace Ave. between Strang and Edenwald Aves., Edenwald Ave. between Grace and Ely Aves.

N. C., Williamston—See "Waterworks."

Ky., Richmond—Until Sept. 4, at office of L. P. Evans, mayor, building 30,831 ft. sanitary and storm sewers, with average cut of 8½ ft. S. F. Crecelius, city engr.; advertised in this issue.

Mich., Lansing—Until Sept. 2, by J. A. Parsons, city clk., building 11,370 ft. 8-36 in. sewers; city to furnish all pipe and castings; advertised in this issue.

Ia., Dexter—H. H. Hough, city clk., receiving bids building sewerage system and sewage disposal plant. Plans include 29,750 ft. 8-12 in. vitr. pipe, 28,880 cu.yd. earth trenching, 450 manholes, 62 cu.yd. filter concrete, 1030 cu.yd. filter sand and 82 cu.yd. filter gravel. T. S. DeLay, Creston, engr.

Ia., Hartley—Until Aug. 26, (change of date), by H. F. Broders, town clk., for construction of 1542 ft. rein.-con. rectangular sewer, ranging in size from 5 ft. x 5 ft. to 3 ft. 6 in. x 3 ft., 386 ft. 36 in. circular sewer, vitr. or segmental block, 1340 ft. 33 in. circular sewer, vitr. or segmental block, 2679 ft. 8-24 in. vitr. sewer pipe, etc. H. R. Green, 197 North 2nd St., Cedar Rapids, engr. Noted Aug. 14.

Ia., Inwood—Until Sept. 1, by city, building sewerage system and sewage disposal plant. C. H. Currie, Webster City, engr.

Ia., Pocahontas—Until Sept. 3, by city, building sewerage system and sewage disposal plant. C. H. Currie, Webster City, engr.

Minn., Walnut Grove—Until Sept. 1, by D. A. Malloy, rec., laying 4465 ft. 80 in. vitr. sewer tile, 2977 ft. 8 in., 1102 ft. 10 in., including 12 lampholes, 62 manholes and disposal plant with septic tank. About $50,000. Druar & Smith, 513 Globe Bldg., St. Paul, engrs. Noted June 12.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**Mass., West Springfield**—City let contract building 8 x 10 in. vitr. pipe sewers, 6 and 7 ft. deep, in various streets, to Middlesex Constr. Co., 7 Water St., Boston, $18,363.

★**Conn., Portland**—Sewer Comn. let contract building sewers in Central Sect., to S. Mazzotta, 90 Spring St., Middletown, $45,560. Noted July 31.

N. Y., New York—F. L. Dowling, pres. Manhattan Boro., received bids Aug. 11, reconstructing sewers in (a) East 72nd St. from 1st to 2nd Aves., (b) F St. and in continuation thereof, now known as Prescott Ave., from Dyckman St. to point 750 ft. north, from Reily Contg. Co., 118 East 89th St., (a) $19,304, (b) $15,327; Walton Contg. Co., 147 West 125th St., (a) $19,351; P. J. Kearns, 2306 Creston Ave., (a) $19,741; A. Gasparini, 1964 Honeywell Ave., (b) $15,311; Lexington Constr. Co., (b) $15,553. Noted Aug. 7.

★**O., Hamilton**—City let contracts to W. M. Davis, Hamilton, building 18 in. sanitary sewers in Ridgelawn Ave., cost $8075, 24 in. storm sewers in Liberty St., $4426; J. L. Walker Co., 231 Court St., building 12-18 in. sanitary sewers in 9th St., $9700.

★ **Mich., Detroit** — City let contract building Virginia Park Relief Sewer in Virginia Park from Wilson to 14th Aves., to W. Blanck & Co., 817 Forn Bldg. About $34,787. Work involves 1920 ft. 4 in. brick pipe. Noted Aug. 14.

★**Mich., Ecorse**—City let contract furnishing labor and material trenching, laying pipes and backfilling complete storm sewer in St. Cosme Ave., to Oakwood Constr. Co., 165 Fort Blvd., Detroit. About $17,500. Work involves 3000 ft. 12-24 in. vitr. pipe. Noted June 12.

★**Mich., Port Huron**—City let contract to C. Mugovero, Port Huron, building lateral sewers in alleys of blocks 181, 204 and 225, from Howard to Pine Sts., cost $2408, blocks 180, 205 and 224, from Pine to Wall Sts., $2612, blocks 179, 206 and 223, from Wall to Court Sts., $2668, blocks 178, 207 and 222, from Court to Union Sts., $4065, blocks 177, 208 and 221, from Union to Chestnut Sts., $4128, blocks 176, 209 and 220, from Chestnut to White Sts., $4121, Jenminson St., from 7th to 10th St., $11,661; to J. Kaumeier, Port Huron, building lateral sewers in Garfield St. from 10th to 12th Aves., $4534, and in 15th St. from North to Beard Sts., $12,061. Noted Aug. 7.

★**Mont., Lewiston** — City let contract building storm sewers and 3905 ft. 8 in. sanitary sewers in Storm Sewer Dist. No. 5, to V. Sigvardt, 509 West Webb St., storm sewers, $8207; sanitary sewers, $5894. Noted June 19.

★**Wash., Vancouver**—City Council let contract building 8 in. sewer in alley between 28th and 29th Sts., from Main to Harney Sts., to C. E. Braley, 1316 Reserve St., $4984; in alley between B and C Sts. from 19th to 25th Sts. and from 25th to 26th Sts., to M. R. Sparks, Vancouver, $5231. Noted Aug. 7.

Ore., Portland—City received bids Aug. 8 building sewerage system in (a) East 37th St. and Raymond Ave., (b) 55th Ave. S. E. and Harold Ave., (1) cement, (2) vitr., from Jacobsen-Jensen Co., 407 Stanton St., (a1) $42,819, (b1) $184,813; J. F. Shea, North 2nd St., (a2) $40,655, (b2) $154,756; Azar & Co., Portland, (a) $42,318. Noted Aug. 14.

Cal., Los Angeles—City received bids building cement pipe sewers in Homer St., et al., from W. Gosling, 3853 Montclair St., $24,888; A. Dalmatin, 818 East 40th St., $28,700; B. Deragno, Los Angeles $35,807.

★**Cal., Redwood City**—City let contract building outfall sewers, to Dreyfus Bros., San Mateo, $20,742. Noted June 19.

★**N. B., Moncton**—City let contract building complete sewerage system in Baraccord St., to L. Stephen & Co., St. John, $12,786.

Bridges

PROPOSED WORK

Conn., New Haven—City plans to issue $250,000 bonds to build concrete and steel bridge over Quinnipiac River near Belle Rock.

Pa., Sunbury—Comrs. Northumberland Co. soon let contract building rein.-con. girder bridge over Chillisquaque Creek, in West Chillisquaque Twp. O. Kramer, co. controller. Noted Oct. 10.

W. Va., Fayetteville—Fayette Co. Highway Dept. had plans prepared building two 25 ft. spans over Laurel Creek and two 60 ft. spans over Paint Creek. About $15,000. J. K. McGrath, Fayetteville, engr.

N. C., Williamston—State Highway Comn., Raleigh, plans to build 3000 ft. concrete bridge over Roanoke River, here. About $350,000. W. S. Fallis, c/o State Highway Dept., Raleigh, engr.

Ill., Carlinville—O. B. Conlee, Macoupin Co. supt. highways, soon lets contract building Armor Bridge, 60 ft. span, 16 ft. roadway, involving 214 cu.yd. concrete, 30,790 lb. reinforcing steel, cost $6900, Corbin Bridge, 30 ft. span, 18 ft. roadway, 97 cu. yd. concrete, 11,920 lb. reinforcing steel, $3460, Sanders Bridge, 50 ft. span, 16 ft. roadway, 186 cu.yd. concrete, 23,870 lb. reinforcing steel, $5800, Sauerwine Bridge, 6 ft. span, 25 cu.yd. concrete, 3245 lb. reinforcing steel, $670, all in Polk Twp.; Loveless Culvert, 4 ft. span, 21 cu.yd. concrete, 3610 lb. reinforcing steel, South Otter Twp., $680; Edminston Bridge, 8 ft. span, 26 cu.yd. concrete, 2650 lb. reinforcing steel, $590, Goshen No. 1 Bridge, 10 ft. span, 42 cu.yd. concrete, 2840 lb. reinforcing steel, $1070, Goshen No. 2 Bridge, 24 ft. span, 24 cu.yd. concrete, 1830 lb. reinforcing steel, $600, Haven Bridge, 8 ft. span, 73 cu.yd. concrete, 6540 lb. reinforcing steel, $2050, all in Barr Twp.; Cline Bridge, 6 ft. span, 42 cu.yd. concrete, 3670 lb. reinforcing steel, Scottsville Twp., $990; Chiles Bridge, 10 ft. span, 43 cu.yd. concrete, 3020 lb. reinforcing steel, $1175, Roades Bridge, 10 ft. span, 3210 lb. reinforcing steel, Bird Twp., $1145; Kahl Bridge, 24 ft. span, 106 cu.yd. concrete, 9520 lb. reinforcing steel, Shipman Twp., $2830. Noted June 5.

Tex., Texarkana—City plans to build steel bridge across Sulphur River at Blackman's Point. About $15,000.

Oregon—State Highway Comn., Portland, rejected bids received Aug. 6 building bridges over Birdseye Creek near Rogue River and over Miller's Gulch on Pacific Highway, Jackson Co., involving 30,000 lb. reinforcing steel, 200 cu.yd. Class "A" concrete, 450 lin.ft. wooden piling, 240 lin.ft. concrete hand rail. H. Nunn, Salem, state highway engr. Noted Aug. 7.

BIDS DESIRED

N. Y., Schenectady—Until Sept. 12, by E. S. Walsh, supt. pub. wks., Capitol, Albany, building abutments and approaches on Schenectady-Scotia bridge, rein.-con., extending from junction of State St. and Washington Ave., across Barge Canal Terminal channel, Van Slyck Island, Barge Canal main channel, Hog Island and the Scotia channel, to point about 300 ft. north of junction of Schonowee and Mohawk Aves., Scotia Village; advertised in this issue.

N. Y., Watertown—Until Aug. 29, by Bd. Pub. Wks., building 2 span. rein.-con. and steel bridge, 200 ft. long, 39 ft. wide, over Black River on Factory St. About $50,000. Concrete Steel Eng. Co., 21 Park Row, New York City, engrs.; advertised in this issue.

Bridges (Continued)

Pa., Dubois—Until Sept. 3, by Comrs. Clearfield Co., building various bridges, here. About $10,000.

Pa., Ebensburg—See "Streets and Roads."

Pa., Washington—Until Aug. 25, by Comrs. Washington Co., for repairs and replacements to inter-county bridge over Monongahela River connecting Donora and Webster. J. S. Sell, controller, Westmoreland Co. T. J. Underwood, controller Washington Co.

W. Va., Kingwood—Until Aug. 26, by Preston Co., building 6 bridges, 1 double 26 ft. span, 2 single 26 ft. spans, 2 single 24 ft. spans and one 16 ft. span, all concrete. E. H. Wilhelm, Kingwood, engr.

W. Va., Wayne—Until Sept. 16, by Wayne Co. building substructure of 150 ft. span, concrete bridge over Twelve Pole Creek. About $10,000. H. Levering, co. engr.

S. C., Beaufort—Until Aug. 29, (change of date) by Comrs. Beaufort Co., setting 7 rein.-con. piers under 400 ft. steel girder bridge over Whale Branch, tearing out wooden piling and concreting steel caisson turn pier, involving 550 cu.yd. rein.-con. and 3.9 tons reinforcing steel. About $14,000. J. R. Pennell, c/o State Highway Dept., Columbia, engr. Noted July 10.

S. C., Chester—Until Sept. 2, by Comrs. Chester Co., building 5 rein.-con. bridges, two 20 ft. clear spans, one 30 ft. clear span, one 60 ft. clear span and one 350 ft. long, all 16 ft. roadway. About $40,000.

Ga., Lagrange—Until Aug. 26, by Bd. Comrs. Rds. & Revenues of Troup Co., building bridge about 3 mi. from Hogansville, involving 111 cu.yd. Class A and 55 cu.yd. Class B concrete, 152 cu.yd. wet and dry excav., 28,000 lb. steel reinforcing, 25 cu.yd. riprap; also bridge about 1 mi. from Louise, 147 cu.yd. Class A and 6 cu.yd. Class B concrete, 150 cu.yd. wet and dry excav., 36,070 lb. reinforcing steel, 25 cu.yd. riprap. W. T. Tuggle, clk.

Ga., Monroe—Until Aug. 27, by Bd. Comrs. Rds. & Revenues of Walton Co., building 48 ft. bridge 1¼ mi. from here, involving 65 cu.yd. Class A and 52 cu.yd. Class B concrete, 98 cu.yd. wet and dry excav., 9395 lb. reinforcing steel, also 190 ft. bridge about 4 mi. from here, involving 252 cu.yd. Class A and 155 cu.yd. Class B concrete, 233 cu.yd. wet and dry excav. and 50,322 lb. reinforcing steel. T. C. Aycock, chn.

Minn., Blue Earth—Until Sept. 2, by J. L. Herring, aud Faribault Co., building Bridge No. 3130, 60 ft. deck girder, 22 ft. roadway, No. 3131, two 30 ft. spans, 20 ft. roadway, No. 3132, 18 ft. slab span 24 ft. roadway, cost $11,500; No. 2322-C, 24 ft. slab span, No. 2687-A, 24 ft. slab span, No. 2733-B, 16 ft. slab span, one 24 ft. slab span, and two box culverts, $10,500. R. J. Short, Blue Earth, engr.

Minn., Slayton—E. V. O'Brien, aud. Murray Co. receiving bids building Bridge No. 3040, 30 ft. rein.-con., rein.-con. abutments, No. 3058, 35 ft. rein.-con., 20 ft. roadway, No. 3155, 23 ft. girder and No. 3157, 16 ft. slab span, both 12 ft. abutments. About $12,000. P. L. Munder, Slayton, engr.

Mo., Charleston—Until Aug. 26, by Mississippi Co. Court, building steel bridges on Section A, Poplar Bluff-Cairo State Rd. About $12,095.

Utah, Salt Lake City—Until Aug. 26, by City Comn., building 68 ft. (exclusive of approaches) rein.-con. arch bridge, 20 ft. wide, cost $20,000; also 48 ft. (exclusive of approaches) rein.-con. arch bridge, 20 ft. wide, on 4th South St., $16,000, both over Jordan River. S. Q. Cannon, city engr.

Cal., Three Rivers—Until Sept. 3, by Bd. Supervs., Tulare Co., Visalia, building rein.-con. bridge over South Fork of Kaweah River, near here, involving 228 cu.yd. rein.-con.

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

N. Y., Lyons—E. S. Walsh, supt. pub. wks., Capitol, Albany, received bids building substructure, superstructure and approaches of highway bridge over Barge Canal below Lock No. 28-A, here, from Lupfer & Remick, Ellicott Sq., Buffalo, $44,105; Scott Bros., Arlington Blk., Rome, $44,987; Lathrop, Shea & Henwood Co., Ellicott Sq., Buffalo, $45,788. Noted July 17 under "Excavation and Dredging, Albany."

N. Y., Rochester—E. S. Walsh, state supt. pub. wks., Capitol, Albany, received only bid completing 2 concrete bridges over Red Creek, Genesse Valley Park, here, Barge Canal Contr. No. 144-A, from Brown & Low Co. and Law Bros., Foster Ave., Schenectady, $69,286. Noted July 17 under "Excavation and Dredging, Albany."

★**N. J., Hoboken**—Delaware, Lackawanna & Western R.R., 90 West St., New York City, let contract building viaduct over tracks on Newark Turnpike, here, to Curtis Brothers, Longshore Ave., Phila. About $160,000.

★**N. J., Plainfield**—Comrs. Union Co. (Elizabeth) let contract building bridge on Sanford Ave., here, to A. E. Smith, 220 Park Ave., $14,745.

★**Pa., Harrisburg**—State Highway Dept. let contract building triple span highway bridge with 3 deck trusses, each 135 ft. 6 in. centre to centre, to Wyoming Co., Nicholson Twp. and Boro., to Anthracite Bridge Co., Mears Bldg., Scranton, $56,536; through truss highway bridge, 138 ft. centre to centre, York Co., York Twp., to C. A. and F. M. Wagman, Dallaston, $28,938. Noted Aug. 7.

★**W. Va., Morgantown**—Monongalia Co. let contracts to B. M. Chaplin Co., Morgantown, building Scotts Run Bridge, cost $8739, and Robinsons Run Bridge, $6485; both concrete girder type.

★**W. Va., Welch**—Comrs. McDowell Co. let contract building 3 rein.-con. bridges, 1 at Iaeger, and 2 near Roderfield, to Crons-Thomas Eng. Contg. Co., Huntington. About $50,000.

★**W. Va., Welch**—McDowell Co. let contracts to Corns-Thomas Eng. Co., 1st Natl. Bank Bldg., Huntington, building 150 ft., steel truss bridge, 16 ft. wide, near Roderfield, involving 1000 cu.yd. concrete and 660 cu.yd. earth approach and fill, State Project No. 1105, cost $22,800; furnishing substructure and building 125 ft. steel truss bridge over Negro Branch Creek, also painting, laying concrete floor and repairing abutments of an old railway bridge, $18,139. Noted July 24.

★**Illinois**—State Highway Comn., Springfield, let contracts to M & P Contract Co., building North River Bridge, Ganeer and Momence Twps., $28,789; Nichols Bridge, Limestone Twp., $1270; to J. A. Devars, Benjamin and Switcher Bridges, Aroma Twp., $2090; to H. Halpin, Cote Bridge, St. Anne Twp., $1120. All in Kankakee Co.

★**Wisconsin**—State Bridge Comn., Madison, let contract building Brown Deer Bridge, Milwaukee Co., Wisconsin Project No. 95, to Michie Constr. Co., 82 Wisconsin St., Milwaukee. Work involves 10,692 cu.yd. earth excav., $0.80 per cu.yd., 32 cu.yd. concrete for culverts, $22.50, 149 cu.yd. concrete for bridges, $19.920 sq.yd. concrete surfacing, $2.24, etc. Total cost $50,746.

★**Tex., Orange**—See "Streets and Roads."

★**Ariz., Phoenix**—T. Maddock, state engr., let contract building 120 ft. rein.-con. arch bridge over Queen Creek, on Mesa-Superior Highway, to Topeka Bridge & Iron Co., Stormont Bldg., Topeka, Kan., $14,000. Noted July 10.

★**Oregon**—State Highway Comn., Portland, let contracts to F. Jordan, Ashland, building 3 rein.-con. bridges over Neil Creek on Pacific Highway, Jackson Co., involving 27,000 lb. reinforcing steel, 375 cu. yd. Class "A" concrete, 600 lin.-ft. wooden piling, 200 lin.ft. concrete hand rail, cost $14,079; to J. F. Clarkson, Vancouver St., Portland, one 108 ft., one 90 ft. and one 70 ft. wood truss span bridges on John Day Highway, near Spray, Wheeler Co., 75 cu.yd. Class "B" concrete, 230 lin.ft. trestle approach, $17,885. Noted Aug. 7.

Oregon—State Highway Comn., Portland, received bids Aug. 6, building bridge over Molalla River on Canby-Aurora Sect. of Pacific Highway near Canby, Clackamas Co., consisting of three 80 ft. steel truss spans, two 30 ft. concrete spans, 266 lin.ft. timber trestle, 624 lin.ft. concrete hand rail, 266 lin.ft. timber superstructure, 1800 lin.ft. trestle piling, 2100 lin.ft. foundation piling, 167,000 lb. structural steel, 45,000 lb. reinforcing steel, 325 cu.yd. Class A concrete, 425 cu.yd. Class B concrete, from R. Wakefield, Worcester Bldg., Portland, $49,518; Portland Bridge Co., Yeon Bldg., Portland, $47,794; Parker & Banfield, Columbia Bldg., Portland, $50,676; 4 culverts and 3 bridges on Holmes-Gap Amity Sect. of West Side Highway, Polk and Yamhill Counties, 50,000 lb. reinforcing steel for bridges, 400 cu.yd. Class A concrete, 300 lin.ft. concrete hand rail, 600 lin.ft. wooden piling, from A. D. Kern, Portland, $18,250. Noted Aug. 7.

Cal., San Diego—Bd. Supervs. San Diego Co. received only bid building 200 ft. rein.-con. girder at La Costa, from De Waard Bros., 207 Granger Bldg., $27,854. Noted July 31.

★**Cal., San Diego**—Bd. Supervs. San Diego Co. let contract building 180 ft. rein.-con. girder bridge near Cardiff, to Johnston & Gaston, San Diego, $26,899. Noted Aug. 7.

Reinforced Concrete

PROPOSED WORK

Pa., Pittsburgh—See "Industrial Works."
Cal., Los Angeles—See "Buildings."

BIDS DESIRED

Ga., Lagrange—See "Bridges."
Ga., Monroe—See "Bridges."

PRICES AND CONTRACTS AWARDED

(★Indicates award of contract)

★**Ariz., Phoenix**—See "Bridges."
★**Cal., San Diego**—See "Bridges."
Cal., San Diego—See "Bridges."
★**Ont., Ottawa**—See "Miscellaneous."

Streets and Roads

PROPOSED WORK

Mass., Pittsfield—City soon receives bids building new concrete sidewalks on Curtiss Terrace, Onota and High Sts. About $10,000.

N. Y., Rome—Bd. Estimate and Apportionment plans to issue $75,000 bonds to resurface various streets. J. L. Plunkett, city engr.

N. J., Elizabeth—Bd. Freeholders Union Co. plan to improve Mountain and Hazlewood Aves. About $60,000. J. Bauer, co. engr.

N. J., Jersey City—City soon lets contract repairing asphalt pavement on various treets. Cost to exceed $10,000. C. A. Van Keuren, city engr.

N. J., Jersey City—City plans to improve Waldo Ave. between Newark Ave. and Pennsylvania R.R. tracks, granite block. About $10,000. C. Van Kueren, city engr.

N. J., North Bergen—Town Council rescinded contract let to J. Devlin, 117 24th St., Guttenberg, repairing 34th and 35th Sts. About $100,000. Work will be readvertised. Noted Aug. 7.

N. J., North Bergen—Town soon lets contract repaving Courtland St., bituminous concrete. About $10,000. Noted Aug. 7.

N. J., Trenton—City plans to repair West Hanover, North Warren, Bellevue, Spring, Lafayette, Liberty, Quarry, Magowan, North Clinton, Cass, Ewing, Carrolls and Clinton Sts., brick and asphalt. A. Swan, city engr.

Pennsylvania—State Highway Dept., Harrisburg, received no bids building 12,355 ft. 1 course rein.-con. or bituminous surface road on concrete foundation, Route No. 57, Rush Twp., Center Co.; 3812 ft. 1 course rein.-con. road, Blairsville Boro, Indiana Co.

Pa., Braddock—Boro. rejected bids grading, paving, curbing and recurbing Braddock Ave., involving 2500 sq.yd. vitr. brick on 6 in. concrete base, 6000 lin.ft. stone curbing and 5000 cu.yd. earth excav. Work will be readvertised soon. Harrop & Hopkins, Home Trust Bldg., Pittsburgh, engrs. Noted May 22.

Pa., East Pittsburgh—City election Aug. 29 to vote on $105,000 bonds to improve streets.

West Virginia—State Highway Comn., Charleston, soon receives bids grading and draining 7 mi. Franklin-Petersburg Rd., 22 ft. wide. About $48,000. Engineer not selected. Address E. Smith, Keyser, div. engr., West Virginia State Rd. Comn.